

Division's Historic Resources Exhibit 13

CULTURAL RESOURCE INVENTORY
OF ALTON COAL DEVELOPMENT'S
SINK VALLEY-ALTON AMPHITHEATER
PROJECT AREA, KANE COUNTY, UTAH

Patricia Stavish

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PROJECT AREA, KANE COUNTY, UTAH

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ABSTRACT

A cultural resource inventory was conducted by Montgomery Archaeological Consultants, Inc. (MOAC) in June 2005 for Alton Coal Development, LLC. The project area is located in the Sink Valley area in the Alton Amphitheater. This is a multiple year proposal in which the company proposes to develop an open pit coal mine south of the town of Alton, Kane County, Utah. This report covers the first phase of the development located on private property. The inventory was implemented at the request of Mr. Allen Childs, Talon Resources, Huntington, Utah. Approximately 433 acres were inventoried, all of which are on private property. The fieldwork was performed between June 2 and 19, 2005 under the supervision of Keith Montgomery, assisted by Meg Thornton, Patricia Stavish, and Andre Jendresen. The inventory was conducted under the auspices of U.S.D.I. (FLPMA) Permit No. 05-UT-60122 and State of Utah Antiquities Project (Survey) No. U-05-MQ-0346p.

The inventory resulted in the documentation of one previously recorded historic/prehistoric site (42Ka2068), five previously recorded prehistoric sites (42Ka1313, 42Ka2041, 42Ka2042, 42Ka2043, and 42Ka2044), and nine new prehistoric sites (42Ka6104, 42Ka6105, 42Ka6106, 42Ka6107, 42Ka6108, 42Ka6109, 42Ka6110, 42Ka6124, and 42Ka6126). The previously recorded historic/prehistoric site (42Ka2068) is recommended as eligible for nomination to the NRHP under Criterion D as both the prehistoric and historic components are likely to contribute to historic and prehistoric research topics of the area. The five previously recorded prehistoric sites (42Ka1313, 42Ka2041, 42Ka2042, 42Ka2043, and 42Ka2044) were initially unevaluated by the recorders. These sites along with the eight new recorded sites (42Ka6104, 42Ka6105, 42Ka6106, 42Ka6107, 42Ka6108, 42Ka6109, 42Ka6110, and 42Ka6126) are recommended eligible to the NRHP under Criterion D because they are likely to contribute to such prehistory of the region. None of these sites meet the requirements defined in Criteria A, B or C. These sites include four prehistoric temporary camps (42Ka1313, 42Ka2042, 42Ka6110 and 42Ka6126) which exhibit diversity of cultural materials, spatial patterning, fire-cracked rock features, and in several cases temporal diagnostics. Cultural traditions represented at these sites include Early and Middle Archaic (42Ka1313), Anasazi (42Ka1313, 42Ka6126), and Protohistoric/Contact or Southern Paiute (42Ka1313, 42Ka6126). Specific research objectives which these sites could address include site function, site structure, chronology, subsistence, technology, spatial organization, land use patterns, and extra-regional relationships.

Nine prehistoric sites in the inventory area are categorized as lithic scatters (42Ka2041, 42Ka2043, 42Ka2044, 42Ka6104, 42Ka6105, 42Ka6106, 42Ka6107, 42Ka6108, and 42Ka6109). These sites display several classes of chipped stone tools with lesser amounts of ground stone implements and ceramic artifacts. Cultural traditions represented at some of the sites include Early Archaic (42Ka2044, 42Ka6108), General Archaic (42Ka6104), Anasazi/Pueblo (42Ka2041), and Protohistoric/Contact or Southern Paiute (42Ka2041, 42Ka2043, 42Ka6105). All of these sites occur in depositional environments (e.g., alluvial) that are likely to yield subsurface cultural remains. Research topics which could be addressed at these sites include site function, chronology, subsistence, technology, and spatial organization, land use patterns, and extra-regional relationships.

Site 42Ka6124, a lithic scatter of unknown cultural affiliation, exhibits a limited artifact assemblage, lacks temporal indicators and has minimal potential for subsurface cultural materials. Therefore, it is recommended as not eligible to NRHP because the site is unlikely to yield information relevant to the research domains of the area.

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The paleontological survey performed by Alden H. Hamblin within the Sink Valley-Alton Amphitheater coal lease project area resulted in the documentation of one fossil site (42Ka12521) found in the Cretaceous Tropic shale formation. The legal description is the E ½, NW ¼ of Section 30 Township 39 South Range 5 West (Appendix B). Paleontological locality 42Ka12521 is an invertebrate locality that includes of bivalves, gastropods, and cephalopods. The site is evaluated as important because it is likely to produce common, abundant fossils for stratigraphic or population variability studies. No further recommendations are provided at this time in terms of treatment.

The cultural resource inventory of Alton Coal Development's Sink Valley area of the Alton Amphitheater resulted in the location of 15 prehistoric or prehistoric/historic sites of which 14 sites (42Ka1313, 42Ka2041, 42Ka2042, 42Ka2043, 42Ka2044, 42Ka2068, 42Ka6104, 42Ka6105, 42Ka6106, 42Ka6107, 42Ka6108, 42Ka6109, 42Ka6110, and 42Ka6126) are considered eligible for nomination to the NRHP under Criterion D. All except two sites (42Ka2068 and 42Ka6108) will be avoided by this phase of the coal development project. The following recommendations are put forth regarding the eligible sites in this project area.

1. All eligible sites except for sites 42Ka2068 and 42Ka6108 will be avoided by the undertaking. Additionally, temporary fencing should be erected around the boundaries of all these eligible sites to facilitate avoidance.
2. It is recommended that a qualified archaeologist should monitor the removal of the topsoil during surface mining activities.
3. The two eligible sites, 42Ka2068 and 42Ka6108, which cannot be avoided by the undertaking will require a data recovery treatment plan.

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INTRODUCTION

A cultural resource inventory was conducted by Montgomery Archaeological Consultants, Inc. (MOAC) in June 2005 for Alton Coal Development, LLC. This is a multiple year proposal in which the company proposes to develop an open pit coal mine within their lease south of the town of Alton, Kane County, Utah. This report covers the first phase of the development located on private property. The inventory was implemented at the request of Mr. Allen Childs, Talon Resources, Huntington, Utah. Approximately 433 acres was inventoried within the Sink Valley area of the Alton Amphitheater.

The objective of the inventory was to locate, document, and evaluate any cultural resources within the project area in order to attain compliance with a number of federal and state mandates, including the National Historic Preservation Act of 1966 (as amended), the National Environmental Policy Act of 1969, the Archaeological and Historic Conservation Act of 1972, the Archaeological Resources Protection Act of 1979, the American Indian Religious Freedom Act of 1978, and the Utah State Antiquities Act of 1973 (amended 1992).

The fieldwork was performed between June 2 and 19, 2005 under the supervision of Keith Montgomery, assisted by Meg Thornton, Patricia Stavish, and Andre Jendresen. The inventory was conducted under the auspices of U.S.D.I. (FLPMA) Permit No. 05-UT-60122 and State of Utah Antiquities Project (Survey) No.U-05-MQ-0346p.

A record search for previous projects and cultural resources was conducted at the Utah State Historic Preservation Office, Salt Lake City on March 25, 2005 by Ms. Marty Thomas. Intensive cultural resource investigations have taken place in the area since the 1980s; however, numerous archaeological sites have been recorded since the 1970s. The majority of the 11 identified inventories were conducted by the Museum of Northern Arizona or Bureau of Land Management and are mostly related to proposed mining activities.

In 1974, the Museum of Northern Arizona (MNA) performed clearance investigations of 48 drilling locations and access routes on the Skutumpah Terrace in Kane County; 19 drilling locations and access routes in the Alton Ampitheater in Kane County; and four meteorological tower sites in Kane County (Davidson, et al. 1974; Project No. U-74-NI-0037bps). Thirty-six archaeological sites were documented during the investigations. One of the sites, 42Ka1313, is located in the current project area. Site 42Ka1313 is a lithic scatter containing chipped stone tools, ground stone implements, and debitage. Interpreted as a knapping station and hunting camp, the site is evaluated as eligible to the NRHP under Criterion D.

In 1979-1980, the Museum of Northern Arizona (MNA) conducted inventories for Utah International, Inc.'s coal mining lease area situated on the Skutumpah Terrace and Alton Amphitheater (Halbirt and Gualtieri 1981; Project No. U-81-NI-0254b and U-80-NM-007). The four surveyed parcels were designated Alton East and Alton West, the coal preparation plant site, and major road routes. A total of 107 archaeological sites, most of which were of prehistoric affiliation were documented dating from the Archaic to Late Prehistoric. A portion of the Alton West parcel is located within the current project area and includes previously documented sites 42Ka2041 through 42Ka2044, and 42Ka2068. These sites consist of lithic scatters, lithic/ceramic scatters, and prehistoric temporary camps, and a lithic scatter with a historic habitation. The original documentation of the sites listed them as unevaluated to the NRHP.

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In 1980, the Bureau of Land Management (BLM) Kanab Field Office performed a Class III inventory of Engineers International, Inc. seismic testing areas (McFadden 1980; Project No. U-80-BL-0162b). No cultural resources were located in the project area. The BLM performed a cultural resource inventory in 1981 of a tract allotment for Heaton Brothers (McFadden 1981; Project No. U-81-BL-0230b). No archaeological sites were documented during the project. The Cone allotment chaining area was surveyed by the BLM in 1982, resulting in a finding of no cultural resources (McFadden 1982; Project No. U-82-BL-0178b).

In 1986, the Museum of Northern Arizona (MNA) performed cultural resource inventories of 43 drill locations and access roads within the Alton Coal Field for Utah International, Inc. (Weaver 1986; Project No. U-86-NI-0279bp). Two new archaeological sites, located outside of the current project area, were documented. Also in 1986, the Museum of Northern Arizona (MNA) performed survey and monitoring of nine test pit locations and access routes for Utah International, Inc. (Weaver and Hurley 1986; Project No. U-86-NI-0864b). No new cultural resources were discovered.

A paleontological literature review was completed by Alden H. Hamblin at the office of the State Paleontologist, Utah Geological Survey (April 2005). This consultation indicated that no paleontological localities have been documented in the current Sink Valley project area. However, there are exposures of the Cretaceous Dakota formation (Sections 19 and 30, T39S R5W) and the Tropic Shale (Sections 19, 20, 29 and 30, T39S R5W) within the current project area. Therefore, it was recommended that a paleontological consultant examine the project area. A paleontological survey was conducted by Alden H. Hamblin during September and October 2005 for the Alton Coal Development project (Appendix B).

DESCRIPTION OF THE PROJECT AREA

The project area is situated in the western portion of Sink Valley within the Alton Amphitheater, Kane County, Utah. This area lies a few miles east of US 89 just south of the town of Alton, Kane County, Utah. The legal description for the current inventory is Township 39 South, Range 5 West, Sections 19, 20, 29, and 30 (Figure 1).

Environmental Setting

The study area lies within the Grand Staircase Section physiographic subdivision of the Colorado Plateau (Stokes 1986). This area is characterized by a series of cliffs and terraces that rise from the Grand Canyon in Arizona to the summit of the High Plateaus in Utah. This section is bounded on the east by the East Kaibab Monocline, on the west by the Hurricane Fault, on the north by the edges of the various high plateaus, and on the south by the Grand Canyon of Arizona. Harder rock layers create cliffs and accompanying benches and tablelands, whereas the softer rock units have eroded into slopes and badlands. Specifically, the project area is located along the western edge of the Paunsaugunt Plateau. The Alton Coal Field is comprised of relatively horizontal bedrock units of Mesozoic age (see Lamm, Appendix C). Within portions of the project area, bedrock units are exposed as low hills and along the incised drainage of Kanab Creek. From the oldest to youngest: the Winsor member of the Carmel formation (Jurassic), the Dakota formation (Cretaceous), and the Tropic shale (Cretaceous). The horizontal deposition of the geologic formations coupled with the impact of water and wind erosion has reduced much of the area to flat ridges and benches which are dissected by long alluvial drainages and tributaries. Drainages often widen to form meadows, such as Sink Valley and the Alton Amphitheater.

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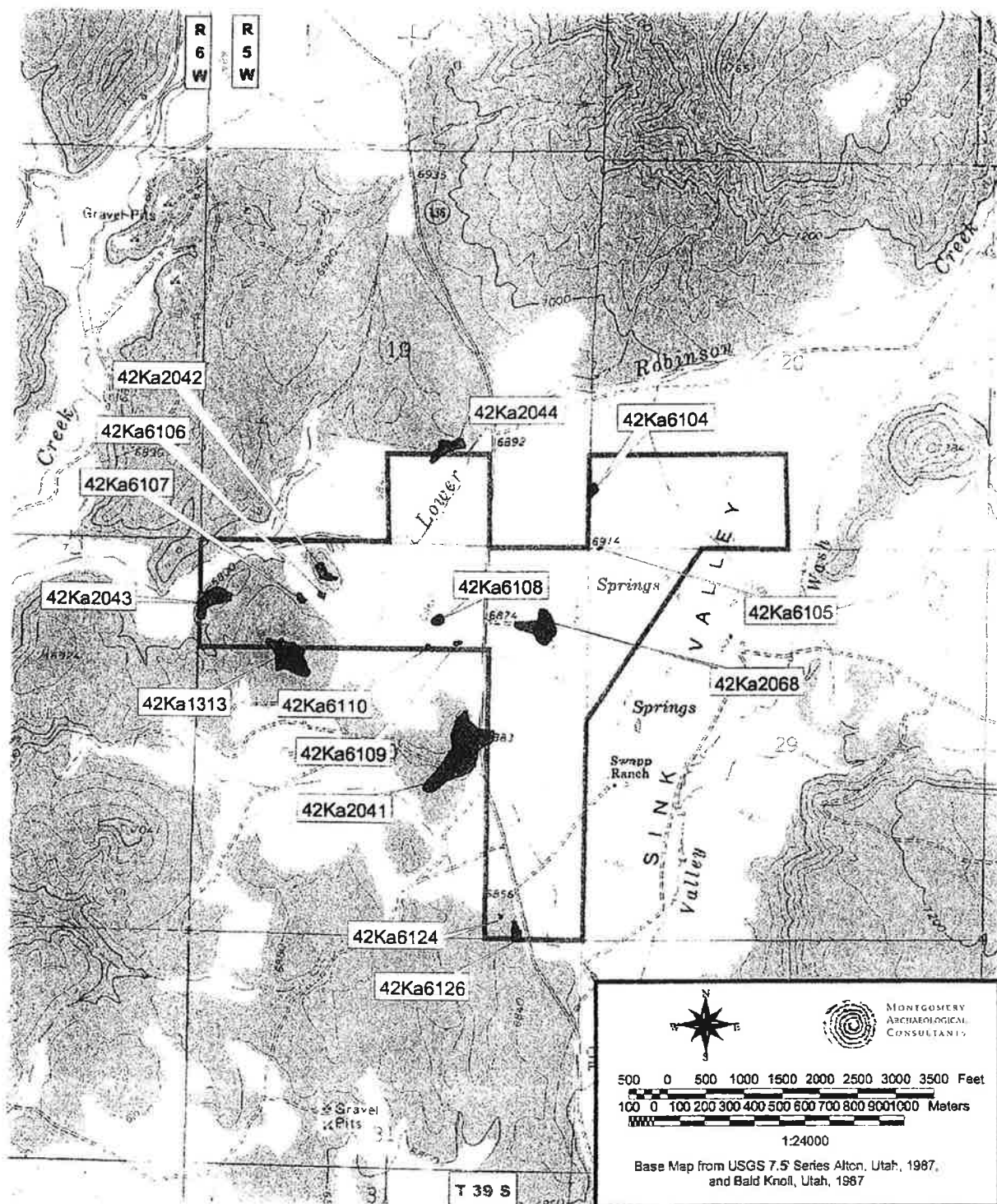


Figure 1. Cultural Resource Inventory of the Proposed Sink Valley Parcel in Alton Amphitheater for Alton Coal Development showing Archeological Sites.

Alluvial valley fill, derived from weathered bedrock, is extensive throughout the project area along the broad, open areas of cultivation and valley floor. Characteristics of the alluvial valley fill include the location of low, relatively level areas of the project including cultivated fields and the presence of incised arroyos and drainages. According to Lamm (Appendix B), total depth of the alluvial valley fill is not known and likely varies across the project area. Soils in the drainages have some agricultural potential as a result of their sand, gravel and silt composition and the presence of limestone and arkosic minerals (Gregory 1951:12). Today less than 2% of the area is under cultivation and products consist of primarily of alfalfa, potatoes, and cold weather vegetables which demand different growing conditions than the prehistoric corn-based agriculture (Halbirt and Gualtieri 1981:6). Major drainages in the project area are Kanab Creek, Sink Hole Valley Wash and Lower Robinson Creek. Kanab Creek flows from north to south through the project area forming an incised canyon, and eventually empties into the Colorado River byway of the Virgin River. In addition, water resources are manifested as geologic aquifers or springs. Most of the springs are perennial and are derived from the Tropic Shale formation.

Elevation in the project area ranges from 6800 ft (2079 m) to 7200 ft (2202 m). Climatic patterns are based on a 59 year record (1915 to 1974) from the Alton, Utah, weather station (Halbirt and Gualtieri 1981:8). The average monthly temperatures are generally mild and follow a modal distribution with a low of 26 degrees F during January and a high of 65 degrees F during July. The number of consecutive frost-free days average between 84 to 104 days (Gregory and Moore 1931). This period is shorter than the necessary 100 to 120 frost-free days required to mature modern hybrid corn, and more time is needed under dry conditions (Crosswhite 1981). The vegetation over most of the study area is a pinyon-juniper and sagebrush community. Pinyon-juniper with oakbrush associations occur on the tops and slopes of ridges, while a sagebrush community exists within alluvial flood plains, draws, and meadows. Other plant species which may have been utilized by ethnographic and prehistoric groups in the area include barberry, canyon grape, cattail, currant, goosefoot, onion, prickly pear cactus, sedge, squawbush, sunflower, and yucca (Ibid:10). Modern impacts of the landscape include ranching, agriculture, coal mining, and roads.

Cultural Overview

Human occupation in the region represents the PaleoIndian, Archaic, Formative, Protohistoric, and Historic cultural stages. The first Native American occupation of the general study area probably occurred during the Paleoindian stage at the late glacial Pleistocene-Holocene boundary (ca. 11,500 B.P. to 9000 B.P.). Early Paleoindian artifact assemblages are typified by large, lanceolate projectile points, spurred end scrapers, graters and borers, and crescents (Frison 1978:78), indicating the exploitation of megafaunal and floral resources. On the basis of projectile point typologies and subsistence strategies, the early portion of the PaleoIndian stage is commonly divided into two cultural complexes referred to as the Clovis (ca. 11,500 - 11,000 B.P.), and the Folsom (ca. 11,000 - 10,000 B.P.). Aikens and Madsen (1986) postulate that PaleoIndian people migrated into the eastern portion of the Great Basin following the recession of Lake Bonneville (10,500 B.P.). Several surface fluted projectile points have been reported from Garfield County (Copeland and Fike 1988) and Washington County (Kohl 1991) as well as northeastern Arizona (Geib 1995). Late Paleoindian or Plano projectile points have been found on the Kaiparowits Plateau and classified as large stemmed or concave base points (Geib, Collette and Spurr 2001:191-192).

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The Archaic stage (7800 to 500 B.C.) is generally viewed as a hunting-gathering lifeway that is represented by subsistence practices more labor-intensive than those of Paleoindians with many more smaller animal and plant species being intensively exploited. Several cultural sequences for the Archaic stage are proposed on the basis of regional differences. Jennings (1978) provides a concept of the western Archaic, or Desert Culture, based on diverse resource exploitation, diagnostic artifacts including cordage and basketry, and artifactual variability in various regions such as the California-Nevada axis and Utah-Oregon axis. Matson (1991) presents a four-period sequence model incorporating data from the Greater Southwest: Early (7800 - 4000 B.C.), Middle (4000 - 2000 B.C.), Late (2000 - 1000 B.C.), and Terminal (1000 B.C. to roughly A.D. 700). South of the study area, the Early Archaic period is labeled the Desha Complex known for its crudely made, shallow, side-notched lanceolate points. In the Glen Canyon region excavations from Sand Dune and Dust Devil Cave provide a radiocarbon date of 5050 to 6050 B.C. Early Archaic component from the former site (Lindsay et al. 1968). About a dozen projectile points were recovered from the lower layer in Sand Dune Cave including Pinto Series, Jay, and varieties of side-notched points (later classified as Sand Dune Side-notched) (Matson 1991:147). Faunal remains recovered from the Desha Complex include those of mountain sheep, cottontail, pack rat, and lesser numbers of jackrabbit, gopher, squirrels, skunk, and bison (one bone). At Dust Devil Cave, the earliest Archaic component (Stratum IV) provided a date from a yucca-lined pit of ca. 8793 B.C. along with an abundance of prickly pear cactus (*Opuntia*) extracted from human feces (Ambler 1996:42). Significant materials recovered from this cave included 25 Archaic sandals, classified into three basic types; open-twined, fine warp-faced, and coarse warp-faced (Ibid 44). On the northern Colorado Plateau the earliest Archaic component is dated at Cowboy Cave (42Wn420) between 7430-7100 B.C. although no artifacts were found in this stratum (Schroedl and Coulam 1994:11). The upper Early Archaic component (Stratum III 5250 to 4350 B.C.), however, contained 11 projectile points (Pinto, Northern Side-notched, and Elko Corner-notched), faunal remains (cottontails, jackrabbits, porcupine, and *Canis* sp.), and floral remains (sunflower, sand dropseed, chenopods, cactus, juniper and bugseed) (Jennings 1980). The most significant features from Stratum III were a number of depressions referred to as "scooped out troughs" by Jennings (1975:9). More recently these features have been redefined by Schroedl and Coulam (1994:6-7) as pitstructures which were repeatedly cleaned-out and reoccupied during the Early Archaic. In the Alton West Coal leasehold previous investigations have documented several Early Archaic projectile points types (Pinto Series, Humboldt, and Northern Side-notched) from sites which include later Formative and Late Prehistoric temporal components (e.g. 42Ka2045 and 42Ka2056) (Halbirt and Gualtieri 1981).

During the Middle Archaic period (4000 - 2000 B.C.) there was a decrease in the occupation of the Colorado Plateau, presumably caused by the Altithermal climate, which may have been a two drought event (Matson 1991:165-166). Many of the previously mentioned sites (Dust Devil Cave and Cowboy Cave) exhibit a reduced intensity of occupation during the Middle Archaic period. Recent radiocarbon data from the Glen Canyon region are filling the Middle Archaic gap (e.g. 1,000 years) as proposed by Berry and Berry (1986) for the Colorado Plateau indicating that the hunter-gatherers of the area may have not completely abandoned the area 6,000 years ago (Geib 1996:32). Middle Archaic settlement patterns most likely reflect the response to a probable protracted drought by populations shifting residential camps to water-rich lowlands and especially higher elevation settings (above 8,000 ft). Common projectile points at Middle Archaic sites include Sudden Side-notched, San Rafael Side-notched, Hawken Side-notched and Elko Series. Previous investigations in the Alton West Coal leasehold have identified similar point types as listed above along with earlier and later temporal components at sites categorized as residential camps and processing stations (Halbirt and Gualtieri 1981).

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The Late Archaic period began around 4,000 years ago and corresponds to a noticeable increase in radiocarbon dates in the region and is temporally correlated with an increase of effective moisture what is termed as the sub-boreal interval (Berry and Berry 1986). This period is marked by a heavy reoccupation of Cowboy Cave starting at about 1750 B.C. and is characterized by the inhabitants engaging in broad-scale hunting and gathering with an increased emphasis on mountain sheep and chenopods/amaranths (Matson 1991:171). Gypsum projectile points comprised approximately 30 percent of the total identifiable collection from Cowboy and adjacent Walters Cave (Jennings 1980:36). These stemmed points are among the most common type of point found in southeastern Utah and appeared on the northern Colorado Plateau sometime after 2550 B.C. (Holmer 1986:105). Split-twig figurines are another important diagnostic of the Late Archaic period, best known from Cowboy Cave, but occur over a broad territory centered on the Colorado River and its tributaries. Further south in the Glen Canyon region, Late Archaic occupations are less represented, although a few Gypsum points were recovered from Dust Devil Cave (Geib and Ambler 1991). On the Kaiparowits Plateau, Late Archaic sites are represented primarily by residential camps situated in the higher elevations with access to ample water, fuel wood, large and small game, and plant resource diversity, whereas, the limited activity camps and reduction loci are prevalent in the lower elevations that contained a greater abundance of economic grasses (Geib, Collette and Spurr 2001:367). Investigations at the Arroyo Site (42Ka3976), situated in The Grand Staircase-Escalante National Monument, revealed a potential pitstructure (dated circa 1850 B.C.) exposed in a trench below a Formative age horizon which was interpreted as a semi-permanent occupation in the floodplain environment (McFadden 2000:15). In the Alton West Coal leasehold several Late Archaic Gypsum projectile have been recorded at open sites with other older and more recent prehistoric temporal components (42Ka2047 and 42Ka2059) (Halbirt and Gualtieri 1981).

The Terminal Archaic (1000 B.C. to roughly A.D. 700) is marked on the northern Colorado Plateau by the presence of arrow points and shafts along with the introduction of corn. The Archaic-Formative transition at Cowboy Cave is found in two separate episodes of occupation beginning about A.D. 100 during a period of high effective moisture (Schroedl and Coulam 1994:23). This relatively intense occupation (Stratum Vb) appeared to have represented a late summer/early fall seed processing locale based on the coprolite evidence (Hogan 1980). A corn cache as well as corn kernels were found in this horizon revealing that the pre-Formative occupants were growing this domesticate, although the extent of agricultural dependency is unknown. It is well established that corn dates to at least 1200 B.C. across much of the southern portion of the Colorado Plateau with later dates derived from sites further north (Geib 1996:54). Even if the populations within this geographical area were not actively involved with farming by around the Christian era, they were likely in contact with farmers or were at least experiencing changes resulting from the presence of nearby farmers. At Hog Canyon Dune (42Ka2574) located at the junction of Hog and Kanab creeks (about two miles north of Kanab) charred corn kernels were recovered from a pitstructure in association with a hearth and a burial that yielded two dates: 910-390 B.C. and A.D. 60-640 (Janetski 1993:229). The dating of bow-and-arrow introduction to the eastern Great Basin and Utah has been an issue of continuing debate. Past evidence from the lithic technologies between the terminal Archaic Proto-Fremont and BM II populations indicates that by ca. A.D. 100 the bow and arrow was employed by the ancestral Fremont, while the ancestral Anasazi continued to employ the atlatl. In the northern portion of the region, at Cowboy Cave, arrow points come from preceramic Stratum V deposited about A.D. 100-600 (Schroedl and Coulam 1994). To the south, the Sunny Beaches site (42Ka2751) in the Glen Canyon Recreational Area is somewhat of an anomaly. A number of Rose Spring Corner-notched points, which are accepted markers of bow-and-arrow technology dated earlier (e.g. around A.D. 100) than the established chronology for BM II aceramic occupations. In the Alton Coal leasehold previous inventories have

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documented Rose Spring Corner-notched arrow points from several sites. At site 42Ka2056 both Early Archaic Pinto Series points and Rose Spring Corner points were found, but in two separate lithic assemblage loci (Halbirt and Gualtieri 1981:85).

The Formative stage began about A.D. 500 when ceramics were in general use on the Colorado Plateau, and continued until A.D. 1300, with the Anasazi abandonment of Four Corners region. Within the region, this stage encompasses two different cultures: the Anasazi (Ancestral Pueblo) and the Fremont. The project area is within the occupation zone of the Anasazi which is divided into two recognizable branches: Virgin Anasazi, primarily occupying the Arizona Strip, southwestern Utah, and southernmost Nevada; and Kayenta Anasazi, occupying a large portion of northern Arizona and far southeastern Utah. The Fremont are considered a separate entity, found primarily at sites in Utah north of the Anasazi region. Artifactual evidence in the study area indicates primarily a Virgin Anasazi cultural tradition, although both Kayenta Anasazi and Fremont ceramics have been identified.

The Virgin Anasazi occupied the area from Basketmaker II through early Pueblo III times, and apparently adapted horticultural practices to a variety of environmental conditions (Thompson and Thompson 1978; Walling and Thompson 1988). Investigations in the Grand Staircase area east of Kanab Creek indicate it was occupied continuously from at least Basketmaker III times (ca. A.D. 300) through late Pueblo II (ca. A.D. 1200). Virgin Anasazi residential units are characterized by an architectural sequence from pithouse residences with separate cist storage facilities, through intermediate stages of room block development, and eventually to substantial surface masonry pueblos incorporating both storage and habitation functions (Talbot 1990). According to McFadden (1996:24), the quantity of storage space per residential unit did not vary significantly which is indicative of a continuity of subsistence practices. In the Grand Staircase region, Virgin Anasazi sites located adjacent to cultivable fields were fully residential with large storage capacities (Ibid 7). Furthermore, residential mobility may have been part of an adaptive strategy that allowed the Virgin Anasazi to engage in agriculture in an environment in which a variety of short-term environmental fluctuations needed to be accommodated. In contrast the Kolob/Skutumpah Terrace area, where the present study area resides (above 6,400 ft), is characterized by a short growing season (less than 120 days at Alton), hence prehistoric agricultural potential was risky. Several studies in this area (Christensen et al. 1983; Halbirt and Gualtieri 1981; Keller 1987:87) indicate that the vast majority of the prehistoric sites are limited activity locales or camps related to hunting and gathering. Documented sites represent Archaic, Virgin or Western Anasazi, and Southern Paiute groups which engaged in hunting and gathering activities most likely on a seasonal basis (Keller 1987). For the entire Alton Coal leasehold, Keller (1987:87) estimates that 23% of the sites date from Basketmaker III to Pueblo II. Data compiled by McFadden (1996:17) from this area, as well as the Grand Staircase and Upper Virgin River, suggests that Virgin Anasazi residential sites are virtually always associated with agricultural potential, while hunting/gathering sites are more common in the elevated zones where agriculture is not feasible. Ceramic types identified in the Alton Coal leasehold are dominated by Virgin Anasazi North Creek Gray, North Creek Corrugated, Shinarump Brown, and St George Black-on-Gray. To a lesser extent Kayenta Anasazi Tusayan Black-on-Gray and Fremont Great Salt Lake Gray have been reported in the area adjacent to Kanab Creek (Halbirt and Gualtieri 1981:35).

In the Grand Staircase physiographic section, the adaptive strategy of the Virgin Anasazi is summarized by McFadden (1996:30) as an occupation of multiple "homesteads" located in a variety of different agricultural niches, each with different characteristics, but all suitable for agriculture. Furthermore, shifts in residence would occur periodically in response to short-term climatic fluctuations, but also as a result of local environmental deterioration. A comparison of site types from the lower elevation study areas and the Kolob and Skutumpah Terrace suggests that given frequent residential moves, the farmsteads themselves could have served as base camp/processing stations with this upland functioning as a hunting-gathering component.

Protohistoric occupation of the project area is attributed to the Southern Paiute, members of the Numic population. Several models address the migration of Numic populations to the Great Basin. Some theorize that Numic expansion from the southwestern Great Basin eastward occurred approximately 1,000 years ago (Madsen 1982:219). Other models view the expansion taking place several thousand years ago (see Bettinger 1994). On the basis of the co-occurrence of Southern Paiute and Virgin Anasazi ceramics in stratigraphic context, it is theorized that entry into the southwestern Utah area by Numic speakers occurred during the late occupational period of the Virgin Anasazi (Westfall et al. 1987). Fowler (1994) compares the material culture of the Southern Paiute to that of the Virgin Anasazi, noting similarities such as clay figurine styles, certain features of coiled basketry, and one type of sandal, and concludes that these similarities suggest interaction between the groups. Besides pottery or perishable materials, the other common diagnostic is the Desert Side-notched projectile point. Although Desert Side-notched points should be considered horizon marker rather than ethnic markers, Southern Paiute use of the study area is well documented (Kelley 1964), and appeared to have constituted the primary post-A.D. 1300 indigenous occupation. Cottonwood Triangular points may not be useful diagnostics of Numic occupations if they are unfinished items broken in production; such tools might have been intended as Desert Side-notched points or Bull Creek points or some other arrow point type (Geib et al. 2001:392). Southern Paiute Brown Ware found in southwest Utah is characterized as conical-bottomed vessels exhibiting undulating surfaces on its thick walls. Decoration is limited to some surface incising, corrugation or fingernail impressions, and/or clapboarding of coils, the former often over the entire surface of the vessel (Baldwin 1950). Temper tends to be visible and coarse and fall into two types for the area: 1) abundant very fine rounded to subangular particles that are generally clear and appear to be frosted suggesting that they originate from eolian and alluvial deposits; 2) large angular to subangular particles most of which are white and very fine grained as if derived from a crushed quartzite or other aphanitic particles (Westfall et al. 1987:70).

The Southern Paiute were hunter-gatherers and part-time horticulturists, with domesticates playing a minor role in their subsistence strategy (Fowler and Fowler 1971, 1981; Steward 1938). This cultural tradition is characterized by the use of rockshelters, and open camp sites containing wickiup-dwellings, rock-filled roasting-pits, fire hearths, conical-bottomed brownware ceramics, rabbit fur blankets, basketry hats and containers, digging sticks, milling stones, and stone tools (Euler 1966; Westfall et al. 1987). Social organization revolved around bands of multiple family units, cooperating and joining forces when necessary to ensure the survival of the community (Steward 1938). At least 16 major bands, or 35 smaller groups, have been identified in Utah. The area adjacent to the present town of Alton was the summer home of one of the seven socio-economic groups that comprised the Kaibab Band of the Southern Paiute (Kelley 1964). The organization of these groups was largely economic in character; however, some attention was allotted to social residence. It appears that the group inhabiting the Alton area was a small patrilocal aggregate. Evidence exists that other groups visited the area occasionally to gather seeds and berries yet there seems to have been minimal economic cooperation between groups.

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(Kelley 1964). The Alton group was controlled by a chief who directed the seasonal movements of camps, and was in most instances in charge of deer hunting (Ibid 27). According to Kelley (Ibid 6), campsite location was determined by the presence of springs which fell under the jurisdiction of the local economic group. Subsistence activities varied according to seasonality, with the occupants of a spring "....tending to share the same seasonal cycle" (Ibid 8). During the winter, the group resided in Kanab Canyon where camps were semi-permanent in the sense that the occupants returned to them following hunting and foraging trips. Resources utilized during this period included seeds and rabbits, the latter hunted in large scale drives consisting of perhaps 25 individuals from different households (Ibid 24). Periodically, deer and pinyon nut forays were also conducted along the top of the Vermillion cliffs. When snows receded in the spring, the group moved north to the Alton area and subsisted until summer on stores of food previously cached in caves (Ibid 16). The group remained in Alton for most of the summer collecting a wide variety of seeds and berries as well as hunting deer, marmot, and rabbit (Halbirt and Gualtieri 1981:15). At some point during this period the group returned briefly to the Kanab area to gather seeds and cache them for the succeeding winter occupation (Kelly 1964:16). Deer hunting and the gathering of "plateau" seeds was emphasized during the late summer to fall months. It is during this period that deer begin to congregate in small migratory groups.

The first documented entry of European Americans into Kane County was the expedition of Fathers Francisco Atanasio Dominguez and Silvestre Velez de Escalante in the autumn of 1776 to establish an overland route between settlements in Santa Fe and Los Angeles. Because of a snowstorm near Milford, the expedition halted the attempt to reach California, and instead followed a route to the southeast to return to Santa Fe. Along this route they named Sulphur Creek (later renamed the Virgin River), Rio de Pilar (later known as Ash Creek), and Hot Sulphur Springs (Alder and Brooks 1996; Bradley 1999). Another early explorer, Jedediah Smith, followed parts of the Dominguez and Escalante Old Spanish Trail, of which various portions were later referred to as the California Trail, through Washington County in 1826 and 1827. His route created a new pathway for pioneers traveling from the East to California, and was widened to an actual wagon road in 1849. Other explorers to follow in these footsteps include John C. Fremont in 1844 and Mormon pioneer leaders from Salt Lake City in 1847 (Alder and Brooks 1996).

Important to the Mormon colonization effort was the organization of an Indian mission in Harmony in early 1854. Jacob Hamblin, a Mormon explorer and settler of Kane County, led the effort to establish harmonious relationships with key Native American leaders. His knowledge of the area also facilitated government exploration and mapping projects in the area, including a Colorado River voyage with John Wesley Powell in 1871 that documented the landscape of Glen Canyon and the present-day city of Kanab. While Kanab is the principal settlement in Kane County, small towns in Long Valley are important centers of agriculture and stock-raising. In 1862, John and William Berry first led a team of ranchers into the Long Valley area in search of rangeland for their cattle. The area was called Long Valley due literally to its length (a long narrow valley situated between high mountain walls), fertile land, and proximity to water. The first settlement in the valley was probably that of Berryville (later renamed Glendale), established by the Berry brothers in 1864. Berryville was abandoned in June 1866 due to conflicts between the Mormon settlers and Paiute and Navajo tribes in the area. This pattern of settlement was common to many of the small towns in Long Valley throughout the late 1800s. On January 16, 1864, the Utah Territorial Legislature approved an act that officially created Kane County. Its boundaries were defined on the west to include the upper Virgin River area, including Virgin City, the principal town in the new county at the time (Bradley 1999:56-59). Kane County remained isolated because of its challenging landscape, its relatively small population, and its lack of connection to railroad lines.

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The town of Alton is a small ranching community located near the head of Long Valley. It originally developed from Upper Kanab. It was first settled by Lorenzo Wesley Roundy when he brought his family to Upper Kanab Creek in 1865. Historically, this area had tall grass, good fodder for their animals, streams of clear water, abundant wildlife in the nearby mountains, berries and other wild fruit, and timber for homes and fences (Bradley 1999:65). The settlement was first called Roundy's Station and the immigrants built two log cabins that first summer. In 1865, the Mormon Church ordered inhabitants of Upper Kanab and other small settlements to go to Kanab, Dixie, and larger towns in the area to help fortify them against Paiute raids (Ibid 65-66). Settlers did not return to Upper Kanab until 1870, when Lorenzo Roundy's nephew, Byron Donalvin Roundy, and his wife settled there. Byron and his brother William Roundy organized a cattle company called the Canaan Cooperative Stock Company, headquartered in St. George. In 1882, Edwin D. Woolley and Daniel Seegmiller also brought their families to settle in Upper Kanab. Two buildings, a schoolhouse and a recreation hall, were erected in 1885 at the head of the Virgin River. During the late 1880s, when the federal government began to crack down on the polygamists of Utah territory, many Mormon men fled to the area to escape marshals (Ibid 143-149). In 1887, the communities of Ranch, Upper Kanab, and Sink Valley joined together to form a LDS ward. In 1908, the town acquired its present-day name of Alton during a May Day celebration drawing. Charles R. Pugh, who had been reading a book about the Alton Fjord in Norway, suggested the name. The population of the town peaked at 350 in the 1930s (Ibid 210). In the post-World War II years, coal reserves were discovered near Alton, and the Smirl-Alton coal mines extracted an average of 40 tons daily in 1949. Today, Alton is home to fewer than 100 people, and its main sources of livelihood stem from the timber industry and its potential for coal mining.

Navajos occupied areas of the Skutumpah Terrace during the post WW-II period (about 1945 to 1970) while cutting and installing cedar fences for local ranchers (Halbirt and Gualtieri 1981:56). Physical remains from the Navajo occupation primarily east of the project area fall into one of the four following categories: 1) forked-stick hogans composed of interlocking poles and a corbelled roof entrance; 2) palisade hogan composed of a corbelled roof supported by four corner posts and a series of stringers which lean against the roof; 3) brush hogan roughly square in plan view and partially supported by two living pinyon trees which provided the superstructure firm support; 4) sweat lodge consisting of three interlocking poles with stringers leaning against the frame and packed with mud daub (Bradley 1999:56).

Today, most traffic through the area is generated by tourists headed to attractions such as Bryce Canyon National Park, Zion National Park, and Grand Staircase-Escalante National Monument. Bryce Canyon, the southern part of which lies in Kane County, was designated a national monument by President Warren G. Harding in 1923, and elevated to National Park status in 1928. Originally, the boundary of Zion National Park ended at the Washington-Kane County State line. In 1930, it was expanded to include part of Kane County, which was made accessible by the Zion-Mt. Carmel tunnel and road (Bradley 1996:218). Grand Staircase-Escalante National Monument was established by President Bill Clinton on September 17, 1996. The monument comprises approximately 1.7 million acres in Kane and Garfield Counties. These major tourist destinations are all accessible via US Highway 89, which bisects Long Valley and proceeds through every town in Kane County except Alton (Ibid 8).

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SURVEY METHODOLOGY

An intensive pedestrian survey was performed for this project which is considered 100% coverage. The project area was examined for cultural resources by the archaeologists walking parallel transects spaced no more than 10 m (30 ft) apart. Ground visibility was considered good. Approximately 433 acres were inventoried on private property.

Cultural resources were recorded as archaeological sites or isolated finds of artifacts. Archaeological sites are defined as spatially definable areas with ten or more artifacts and/or features. Sites were documented by the archaeologists walking transects across the site, spaced no more than 3 m (10 ft) apart and marking the locations of cultural materials with pinflags. This procedure allowed clear definition of site boundaries and artifact concentrations. At the completion of the surface inspection, a handheld GEO XT Trimble GPS unit was employed to point-provenience diagnostic artifacts and other relevant features in reference to the site datum, a steel rebar stamped with a temporary site number. A judgmental lithic analysis sample unit (a 2x2 meter count grid) was utilized for archaeological sites with dense lithic debitage assemblages. Also, where lithic densities were variable within the site, judgmental sample units were employed to reflect such density changes. Archaeological sites were plotted on a 7.5' USGS quadrangle, photographed, and documented with site data entered on an Intermountain Antiquities Computer System (IMACS, 1990 version) inventory form (Appendix A).

INVENTORY RESULTS

The inventory resulted in the documentation of one previously recorded historic/prehistoric site (42Ka2068), five previously recorded prehistoric sites (42Ka1313, 42Ka2041, 42Ka2042, 42Ka2043, and 42Ka2044), and nine new prehistoric sites (42Ka6104, 42Ka6105, 42Ka6106, 42Ka6107, 42Ka6108, 42Ka6109, 42Ka6110, 42Ka6124, and 42Ka6126) (Table 1).

Table 1. Site type and NRHP eligibility of sites located in the Sink Valley-Alton Amphitheater.

MOAC Site Number	State Site Number	Site Type	Cultural Affiliation	NRHP Eligibility
05-95-6	42Ka1313	Temporary Camp	Archaic, Anasazi, Protohistoric/Contact	Eligible
N/A	42Ka2041	Lithic Scatter	Anasazi, Southern Paiute	Eligible
N/A	42Ka2042	Temporary Camp	Unknown	Eligible
N/A	42Ka2043	Lithic Scatter	Protohistoric/Contact	Eligible
N/A	42Ka2044	Lithic Scatter	Archaic	Eligible
N/A	42Ka2068	Historic Habitation and Prehistoric Lithic Scatter	Unknown Prehistoric Euro-American	Eligible
05-95-14	42Ka6104	Lithic Scatter	Archaic	Eligible
05-95-15	42Ka6105	Lithic Scatter	Protohistoric/Contact	Eligible
05-95-9	42Ka6106	Lithic Scatter	Unknown	Eligible
05-95-8	42Ka6107	Lithic Scatter	Unknown	Eligible
05-95-10	42Ka6108	Lithic Scatter	Early Archaic	Eligible
05-95-13	42Ka6109	Lithic Scatter	Unknown	Eligible
05-95-11	42Ka6110	Temporary Camp	Unknown	Eligible
05-95-19	42Ka6124	Lithic Scatter	Unknown	Not Eligible
05-95-18	42Ka6126	Temporary Camp	Anasazi, Southern Paiute	Eligible

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Archaeological Sites

Smithsonian Site No.: 42Ka1313
Temporary Site No.: MOAC 05-95-6
Legal Description: T 39S, R 5W, Sec. 30
NRHP Eligibility: Eligible under Criterion D

Description: This is an extensive prehistoric temporary camp which exhibits a broad occupational span (Early and Middle Archaic, Pueblo II, and Protohistoric/Contact). It is situated on the top and southern slope of a ridge in the Alton Amphitheater. A two track bisects the site northwest to southeast. The site measures 227 by 136 meters and is situated in a pinyon-juniper woodland. Cultural materials include ceramics (n=2), ground stone implements (n=2), chipped stone tools (n=52), and debitage. Ceramics consist of two Tusayan Dogoszhi Black-on-White sherds which date to the Pueblo II period. Ground stone implements are two miscellaneous ground fragments (Tools 2 and 28). Temporally diagnostic chipped stone artifacts include a Hawken Side-notched projectile point (Tool 33), a Northern Side-notched projectile point (Tool 31) and two Desert Side-notched projectile points (Tools 11 and 17). Other chipped stone tools include 13 unknown projectile points, 24 bifaces, two cores, and nine utilized flakes. Lithic debitage (n=998) is dominated by tertiary flakes manufactured from various chert, quartzite, and obsidian materials. Feature A is a concentration of 40-50 fire-cracked sandstone rocks within a one meter diameter area which lacks evidence of dark soil.

Smithsonian Site No.: 42Ka2041
Temporary Site No.: None
Legal Description: T 39S, R 5W, Sec. 30
NRHP Eligibility: Eligible under Criterion D

Description: This is a lithic and ceramic scatter with two cultural components (Anasazi and Protohistoric/Contact) located on a slight rise in an otherwise flat area of Alton Amphitheater. The site measures 120 by 360 meters and lies in a pinyon-juniper woodland. A county road bisects the easternmost portion of the site and another road bisects the site in the south. Cultural materials consist of ceramics, chipped stone tools, an unknown ground stone implement, and lithic debitage. Ceramics consist of one undetermined Virgin Series sherd and a Southern Paiute Utility Ware sherd. Chipped stone tools include two Desert Side-notched projectile points (Tools 5 and 13), five unknown projectile points fragments, one utilized flake, five bifaces, three cores, and a worked piece of glass. The lithic debitage (n=274) is dominated by tertiary flakes manufactured from several chert, quartzite, and obsidian material types. No features were found at this site however, the site has good potential for subsurface cultural materials.

Smithsonian Site No.: 42Ka2042
Temporary Site No.: None
Legal Description: T 39S, R 5W, Sec. 30
NRHP Eligibility: Eligible under Criterion D

Description: This is a prehistoric temporary camp of unknown cultural affiliation located on the top and slope of a knoll in Alton Amphitheater. The site measures 35 by 90 meters and is in a pinyon-juniper woodland. Cultural materials consist of a ground stone implement (Tool 1), chipped stone tools, and lithic debitage. Chipped stone tools are one utilized flake (Tool 4), three bifaces (Tools 3, 6, and 7), two cores (Tools 2 and 8), and a hammerstone (Tool 5). Lithic debitage (n=171) is dominated by tertiary reduction flakes manufactured from several chert, quartzite, and obsidian materials. Feature A is a concentration of fire-cracked rock and lithic debitage located on a slope near a small drainage system. The concentration of fire-cracked rock is within an area of darkened soil and measures 7 m in diameter.

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Smithsonian Site No.: 42Ka2043
Temporary Site No.: None
Legal Description: T 39S, R 5W, Sec. 30
NRHP Eligibility: Eligible under Criterion D

Description: This is a Protohistoric/Contact period lithic scatter located on a ridge top in Alton Amphitheater. The site measures 65 by 155 meters and is in a pinyon-juniper woodland. Cultural materials consist of a ground stone trough metate, chipped stone tools, and lithic debitage. Chipped stone tools include a Desert Side-notched projectile point (Tool 8), five unknown projectile point fragments, 12 utilized flakes, five bifaces, and one core. The lithic debitage (n=241) is dominated by tertiary reduction flakes and shatter manufactured from several chert material types. No features were found at this site; however, the site has good potential for subsurface cultural materials.

Smithsonian Site No.: 42Ka2044
Temporary Site No.: None
Legal Description: T 39S, R 5W, Sec. 19
NRHP Eligibility: Eligible under Criterion D

Description: This is an Archaic temporary camp located on the top of a low ridge in Alton Amphitheater. The site measures 40 by 160 meters and is in a pinyon-juniper woodland. Cultural materials consist of chipped stone tools and lithic debitage. Diagnostic artifacts include a Rocker Side-notched projectile point (Tool 3), a utilized flake, and a core. Lithic debitage (n=149) is dominated by shatter manufactured from chert, quartzite, and obsidian materials. The site also contains three collectors' piles of 100+ flakes in total. Feature A is a semicircle of fire-cracked rock associated with a quartzite core (Tool 2) and a heat treated flake. The soil does not appear to be discolored, however the soil does appear to be disturbed by rodent activity.

Smithsonian Site No.: 42Ka2068
Temporary Site No.: None
Legal Description: T 39S, R 5W, Sec. 30
NRHP Eligibility: Eligible under Criterion D

Description: The site consists of a prehistoric lithic scatter of unknown cultural affiliation and an abandoned historic farming/ranching habitation. It is located in the valley of the Alton Amphitheater on a small rise and the surrounding slope and undulating field. The historic component partially overlaps the prehistoric component; however, portions of the aboriginal occupation still retains integrity. The historic habitation measures 170 by 150 meters and the prehistoric lithic scatter measures 110 by 40 meters. Both sites are situated in an agricultural field with low sagebrush and small bunch grasses.

----- Prehistoric cultural material include chipped stone tools and lithic debitage. Diagnostic artifacts consist of a projectile point midsection (Tool 1) and one biface fragment (Tool 2). Lithic debitage (n=74) is dominated by shatter manufactured from various chert and obsidian types. No prehistoric cultural features were observed at this site.

The historic component represents an abandoned farming/ranching habitation and contains several structures, both architectural and landscape, as well as artifacts. The property was patented by James Swappe on August 9, 1889 under the Homestead Act of 1862. Mr. C. Butron Pugh, a historic informant, stated that his grandfather purchased the ranch in 1908 from the Robinson family (personal communication, 2006). This site was previously recorded in 1983 and was described as containing a barn, a shed, a bunkhouse and a corral. Mr. Pugh stated that in addition to the currently visible structures (granary, corral, and cellar) other structures located on

the ranch included a small three room house, a large barn with a stone/rock foundation, a blacksmith shop, a bunk house, a washhouse, a springhouse, two outhouses (used consecutively), and "rip-gut" or pitchpole fencing to the north.

The current survey documented a granary, a corral, a cellar, several fences, and historic artifacts. The granary is constructed of lumber, log, and stone and was divided into two rooms with storage above. The granary is slightly elevated from the ground surface by log stilts, a stone foundation, possible ditching around the stone foundation; perhaps as a measure to avoid flooding and/or rodent infestations. This structure is constructed with large log cross beams, and V-shaped log construction, and lumber paneling and floorboards. The roof has collapsed into the building and the door frames are partially collapsed and the two doors are blocked. Mr. Pugh stated that the door hinges for the granary were made at the on-site blacksmith shop. One room contained several hooks and some leather strapping, while the other room is completely open and a half swing door connects the two rooms. The storage area above has remnants of hay.

The corral is constructed from a series of log fences and upright log supports. The shoot is made of milled lumber with a couple log beams at main support locations. The corral has been reinforced with wire and some metal fencing and has been used into the 1980's according to the original investigator and Mr. Pugh. The corral also contains an old dodge shoot that was used to separate the sheep herds.

The masonry cellar is approximately 120 cm deep with the uppermost level of stone collapsing. The walls are otherwise still in good condition. The log beams that would have supported the ceiling for the cellar are partially burnt and caved in. The cellar depression is partially filled with various debris including glass jars and bottles, metal cans, and some plastic bottles with materials dating between 1920 and 1980s. Mr. Pugh stated that the cellar was used to store and to age cheese made by his grandmother.

Three fences surround the site area: one lines the two-track drive; one fence marks a field boundary on the north side of the two-track; and one fence marks a field boundary on the south side of the two-track. Landscape features include the agricultural field around the granary and corral and the oak trees. To the east of the granary there is also a stand of live oaks and rip-gut fencing with a large quantity of cultivated wild rose bushes. Mr. Pugh stated that much of the rip-gut fencing is in good condition, however, several of the uprights were replaced in the 1950's due to rotting.

Historic artifacts include glass, ceramic, and other domestic items. Glass consists of several hundred brown and clear fragments, and lesser amounts of amethyst and aqua-colored glass. A significant amount of the container fragments are likely from canning jars, although few metal canning rings were found. None of the glass artifacts had manufacture's trademarks which would have aided in temporality. Most of the ceramics occurred where the large house was said to have been. The most prevalent type of ceramic was the hard paste porcelain "Boyd's Genuine Porcelain Lined Cap" canning lid. In addition a Flow Blue vessel sherds (est. 1820-1870), decal decorated sherds, and plain whiteware fragments were observed. Most of the tin cans were deposited in the open cellar. These include four "Punch Here" milk cans, a Spam meat can, an internal friction cocoa can, and four oil cans.

Smithsonian Site No.: 42Ka6104
Temporary Site No.: MOAC 05-95-14
Legal Description: T 39S, R 5W, Sec. 20
NRHP Eligibility: Eligible under Criterion D

Description: The site is an Archaic-affiliated sparse lithic scatter located on the slope of a low north-south trending ridge in Sink Valley. It measures 66 by 41 meters and is in a pinyon-juniper woodland with low sagebrush. Cultural materials include chipped stone tools and lithic debitage. Diagnostic artifacts consist of a heat treated Elko projectile point (Tool 5), an unknown projectile point fragment (Tool 2), three bifaces (Tools 1, 4, and 6), a utilized flake (Tool 3), and a core (Tool 7). Lithic debitage (n=29) is dominated by shatter manufactured from various types of chert and quartzite material types. No features were found at this site; however, the site has good potential for subsurface cultural materials.

Smithsonian Site No.: 42Ka6105
Temporary Site No.: MOAC 05-95-15
Legal Description: T 39S, R 5W, Sec. 20
NRHP Eligibility: Eligible under Criterion D

Description: This is a low density lithic scatter of Protohistoric/Contact affiliation located at the bottom of a southwest facing slope in Sink Valley. The site measures 22 by 9 meters and is in a low sagebrush community. Cultural materials include chipped stone tools and lithic debitage. Diagnostic artifacts consist of a chert Desert Side-notched projectile point (Tool 3) and two chert bifaces (Tools 1 and 2). The lithic debitage (n=18) is dominated by shatter manufactured from various chert, quartzite, and obsidian material types. No features were found at this site; however, the site has good potential for subsurface cultural materials.

Smithsonian Site No.: 42Ka6106
Temporary Site No.: MOAC 05-95-9
Legal Description: T 39S, R 5W, Sec. 30
NRHP Eligibility: Eligible under Criterion D

Description: The site consists of a sparse prehistoric lithic scatter of unknown cultural affiliation. It is located at the base of a southwest facing slope in Sink Valley. The site measures 29 by 27 meters and is in a low sagebrush community. Cultural materials include chipped stone tools and lithic debitage. Diagnostic artifacts consist of an untyped chert projectile point and a chert awl/drill. Lithic debitage (n=18) is dominated by shatter manufactured from various chert and obsidian material types. No features were found at this site; however, the site has good potential for subsurface cultural materials.

Smithsonian Site No.: 42Ka6107
Temporary Site No.: MOAC 05-95-8
Legal Description: T 39S, R 5W, Sec. 30
NRHP Eligibility: Eligible under Criterion D

Description: The site is a prehistoric lithic scatter of unknown cultural affiliation. It is located near three drainages at the bottom of a northeast facing slope in the Alton Amphitheater. The site measures 50 by 21 meters and occur in pinyon-juniper woodland with low sagebrush. Cultural materials include chipped stone tools (utilized flakes) and lithic debitage. Debitage (n=34) is dominated by shatter manufactured from various chert, quartzite, and obsidian material types. No features were found at this site; however, the site has good potential for subsurface cultural materials.

Smithsonian Site No.: 42Ka6108
Temporary Site No.: MOAC 05-95-10
Legal Description: T 39S, R 5W, Sec. 30
NRHP Eligibility: Eligible under Criterion D

Description: This is an Early Archaic-affiliated dense, lithic scatter located on a small rise and slope along the west side of Sink Valley. The site measures 53 by 40 meters and is in a pinyon-juniper woodland with low sagebrush. Cultural materials consist of chipped stone tools (n=19) and lithic debitage. Diagnostic artifacts consist of a chert Hawken Side-notched projectile point (Tool 1), an unknown projectile point fragment, 10 utilized flakes, and seven bifaces. Lithic debitage (200+) is dominated by shatter manufactured from various chert and obsidian material types. Two historic artifacts were observed, a hole-in-top milk can and an earthenware vessel sherd. No features were found at this site; however, the site has good potential for subsurface cultural materials.

Smithsonian Site No.: 42Ka6109
Temporary Site No.: MOAC 05-95-13
Legal Description: T 39S, R 5W, Sec. 30
NRHP Eligibility: Eligible under Criterion D

Description: The site is a sparse lithic scatter of unknown aboriginal affiliation located along the western edge of Sink Valley. It measures 33 by 19 meters and is in an area of low sagebrush. The cultural materials consist of chipped stone tools and lithic debitage. The chipped stone tools consist of a stage 4 chert biface (Tool 1) and a stage 2 chert biface fragment (Tool 2). Lithic debitage (n=50) is dominated by shatter manufactured from various chert material types. No features were found at this site; however, the site has good potential for subsurface cultural materials.

Smithsonian Site No.: 42Ka6110
Temporary Site No.: MOAC 05-95-11
Legal Description: T 39S, R 5W, Sec. 30
NRHP Eligibility: Eligible under Criterion D

Description: This is a prehistoric temporary camp of unknown cultural affiliation located on a slight rise along the western margin of Sink Valley. The site measures 23 by 19 meters and is in a pinyon-juniper woodland with low sagebrush. Cultural materials consist of chipped stone tools and lithic debitage. Diagnostic artifacts consist of two unknown chert projectile point fragments. Lithic debitage (100-150) is dominated by shatter manufactured from various quartzite and chert material types. Feature A is an oblong concentration of fire-cracked sandstone rocks, with no discernible change in the soil color surrounding it, although there is potential for cultural fill.

Smithsonian Site No.: 42Ka6124
Temporary Site No.: MOAC 05-95-19
Legal Description: T 39S, R 5W, Sec. 30
NRHP Eligibility: Not Eligible

Description: The site is a concentrated lithic scatter of unknown prehistoric cultural affiliation located on a wooded ridge top in the Alton Amphitheater. The site measures 22 by 14 meters and is in a pinyon-juniper woodland. Cultural materials consist of chipped stone tools and lithic debitage. Diagnostic artifacts include one chert untyped projectile point fragment (Tool 1), a chert biface (Tool 2), and one obsidian biface fragment (Tool 3). Lithic debitage (n=10) is dominated by shatter manufactured from obsidian, chert, and quartzite material types. No features were found on this site.

Smithsonian Site No.: 42Ka6126
Temporary Site No.: MOAC 05-95-18
Legal Description: T 39S, R 5W, Sec. 30
NRHP Eligibility: Eligible under Criterion D

Description: The site is a prehistoric temporary camp representing Anasazi/Pueblo and Southern Paiute cultural traditions. The site is at the base of an east-facing slope in the Alton Amphitheater. The site measures 90 by 50 meters and is in a pinyon-juniper woodland. Cultural materials include chipped stone tools, lithic debitage and ceramics. Diagnostic stone tools include an obsidian Elko Series projectile point (Tool 9) and a chert Cottonwood Triangular projectile point (Tool 10). Other chipped stone tools include three unknown projectile point fragments, two utilized flakes, one core, a biface, and one utilized core. Lithic debitage (50-100) is dominated by shatter manufactured from various chert and quartzite material types. Ceramic artifacts consist of four Virgin Anasazi whiteware sherds and three Southern Paiute Utility Ware sherds. Feature A is a small concentration of 15-20 fire-cracked sandstone rocks, which measures approximately 50 cm in diameter. The feature does not exhibit any discernible change in the soil color.

NATIONAL REGISTER OF HISTORIC PLACES EVALUATION

The National Register Criteria for Evaluation of Significance and procedures for nominating cultural resources to the NRHP are outlined in 36 CFR 60.4 as follows:

The quality of significance in American history, architecture, archaeology, and culture is present in districts, sites, buildings, structures, and objects of State and local importance that possess integrity of location, design, setting, material, workmanship, feeling, and association, and that they:

- a)...are associated with events that have made a significant contribution to the broad patterns of our history; or
- b)...are associated with the lives of persons significant to our past; or
- c)...embody the distinctive characteristics of a type, period, or method of construction; or that represents the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
- d)...have yielded or may be likely to yield information important in prehistory or history.

The inventory resulted in the documentation of one previously recorded historic/prehistoric site (42Ka2068), five previously recorded prehistoric sites (42Ka1313, 42Ka2041, 42Ka2042, 42Ka2043, and 42Ka2044), and nine new prehistoric sites (42Ka6104, 42Ka6105, 42Ka6106, 42Ka6107, 42Ka6108, 42Ka6109, 42Ka6110, 42Ka6124, and 42Ka6126). The previously recorded historic/prehistoric site (42Ka2068) is recommended as eligible for nomination to the NRHP under Criterion D as both the prehistoric and historic components are likely to contribute to historic and prehistoric research topics of the area. The prehistoric component of site 42Ka2068 is a lithic scatter of unknown cultural affiliation that exhibits spatial integrity, a diversity of lithic artifacts, and the potential for additional subsurface cultural remains. The historic component, an abandoned farming/ranching habitation, is also considered significant because of its information potential concerning spatial patterning, trash disposal patterns, consumer behavior, and socioeconomic status.

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The five previously recorded prehistoric sites (42Ka1313, 42Ka2041, 42Ka2042, 42Ka2043, and 42Ka2044) were initially unevaluated by the recorders. These sites along with the eight new recorded sites (42Ka6104, 42Ka6105, 42Ka6106, 42Ka6107, 42Ka6108, 42Ka6109, 42Ka6110, and 42Ka6126) are recommended eligible to the NRHP under Criterion D because they are likely to contribute to such prehistory of the region. None of these sites meet the requirements defined in Criteria A, B or C. These sites include four prehistoric temporary camps (42Ka1313, 42Ka2042, 42Ka6110 and 42Ka6126) which exhibit diversity of cultural materials, spatial patterning, fire-cracked rock features, and in several cases temporal diagnostics. Cultural traditions represented at these sites include Early and Middle Archaic (42Ka1313), Anasazi (42Ka1313, 42Ka6126), and Protohistoric/Contact or Southern Paiute (42Ka1313, 42Ka6126). Specific research objectives which these sites could address include site function, site structure, chronology, subsistence, technology, spatial organization, land use patterns, and extra-regional relationships.

Nine prehistoric sites in the inventory area are categorized as lithic scatters (42Ka2041, 42Ka2043, 42Ka2044, 42Ka6104, 42Ka6105, 42Ka6106, 42Ka6107, 42Ka6108, and 42Ka6109). These sites display several classes of chipped stone tools with lesser amounts of ground stone implements and ceramic artifacts. Cultural traditions represented at some of the sites include Early Archaic (42Ka2044, 42Ka6108), General Archaic (42Ka6104), Anasazi/Pueblo (42Ka2041), and Protohistoric/Contact or Southern Paiute (42Ka2041, 42Ka2043, 42Ka6105). All of these sites occur in depositional environments (e.g., alluvial) that are likely to yield subsurface cultural remains. Research topics which could be addressed at these sites include site function, chronology, subsistence, technology, and spatial organization, land use patterns, and extra-regional relationships.

Site 42Ka6124, a lithic scatter of unknown cultural affiliation, exhibits a limited artifact assemblage, lacks temporal indicators and has minimal potential for subsurface cultural materials. Therefore, it is recommended as not eligible to NRHP because the site is unlikely to yield information relevant to the research domains of the area.

MANAGEMENT RECOMMENDATIONS

The cultural resource inventory of Alton Coal Development's Sink Valley area of the Alton Amphitheater resulted in the location of 15 prehistoric or prehistoric/historic sites of which 14 sites (42Ka1313, 42Ka2041, 42Ka2042, 42Ka2043, 42Ka2044, 42Ka2068, 42Ka6104, 42Ka6105, 42Ka6106, 42Ka6107, 42Ka6108, 42Ka6109, 42Ka6110, and 42Ka6126) are considered eligible for nomination to the NRHP under Criterion D. All except two sites (42Ka2068 and 42Ka6108) will be avoided by this phase of the coal development project. The following recommendations are put forth regarding the eligible sites in this project area:

1. All eligible sites except for sites 42Ka2068 and 42Ka6108 will be avoided by the undertaking. Additionally, temporary fencing should be erected around the boundaries of all these eligible sites to facilitate avoidance.
2. It is recommended that a qualified archaeologist should monitor the removal of the topsoil during all surface mining activities because of the potential for subsurface cultural remains..
3. The two eligible sites, 42Ka2068 and 42Ka6108, which cannot be avoided by the undertaking will require a data recovery treatment plan.

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APPENDIX A

INTERMOUNTAIN ANTIQUITIES COMPUTER SYSTEM (IMACS)
SITE FORMS

(42Ka1313, 42Ka2041 through 42Ka2044, 42Ka2068,
42Ka6104 through 42Ka6110, 42Ka6124, and 42Ka6126)

On File At:

Utah Division of State History
Salt Lake City, Utah

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APPENDIX B

ALTON COAL FIELD
PALEONTOLOGICAL SURVEY
SECTIONS 12, 13, 24, AND 25, T 39 S, R 6 W AND
SECTIONS 7, 18, 19, 30 AND 31, T 39 S, R 5 W

ALTON COAL FIELD

PALEONTOLOGICAL SURVEY

Sections 12, 13, 24, and 25, T 39 S, R 6 W and

Sections 7, 18, 19, 30 and 31, T 39 S, R 5 W

For

**Montgomery Archaeological Consultants
Box 147, 322 East 100 South
Moab, Utah 84532**

By

**Alden H. Hamblin
A.H. Hamblin Paleontological Consulting
3793 N. Minersville Hwy
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February 8, 2006

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INTRODUCTION

This is a paleontology field survey report for the Alton Coal Field covering sections 12, 13, 24, and 25, T 39 S, R 6 W and sections 7, 18, 19, 30 and 31, T 39 S, R 5 W. This area is south and east of the town of Alton, Utah. An earlier report covered a literature and file search on a slightly larger area than the present study (Hamblin, 2005).

The earlier report discussed the paleontology of five geological formations: Dakota Formation, Tropic Shale, Straight Cliff Formation, Wahweap Formation, and Claron Formation. The project boundaries of the present study only contained areas with the Dakota Formation and Tropic Shale.

The survey was conducted during September and October 2005. Formation outcrops of the Dakota Formation and Tropic Shale were identified using the Geologic Map of Kane County (Doelling and Davis, 1989) and the Coal and geology map, Alton Quadrangle in Doelling and Graham (1972). The survey was conducted by selecting spots or areas in formation outcrops and hiking around looking for fossil material.

SURVEY RESULTS

Three fossil localities had been recorded in or near the present study area during a survey by DeCourten (1987). These localities were Ka270I, Ka271V, and Ka272V and included mollusk fragments and turtle shell bone. The present survey identified 77 additional fossil sites in the study area. These were combined into 30 recorded paleontology localities (Ka1243 – Ka1272). Paleontology Data Sheets on these 30 localities are included in the appendix of this report. Figure 1 is a map of the fossil locations in and near the study area. Figure 2 shows example of fossils in the study area.

Tropic Shale

The study area is highly fossiliferous with common, well known invertebrate fossils of Cretaceous Age. Almost anywhere one walks in the Tropic Shale in this area one can find invertebrate fossils, mostly bivalves, but also gastropods, and cephalopods. Most of the recorded localities are in the Tropic Shale. The fossils generally occur in clay beds, but many seem to be associated with the occurrence of nodules or concretions in the clay beds. Bivalves and gastropods were also found in sandstones in the higher layers of the Tropic Shale in the hills on the east side of the study area. The most common fossil observed was that of the oyster *Pycnodonte newberryi*. The cephalopod *Baculites* sp. is also fairly common. The marine fossils of the Tropic Shale record the transgression and regression of the last Cretaceous seaway in this area.

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Dakota Formation

The Tropic Shale was deposited over the Dakota Formation which contains the coal deposits of the Alton Coal Field. Fossils are also found in the Dakota Formation. These tend to be less marine oriented and there is a greater potential for finding terrestrial vertebrate fossils in the Dakota Formation. Turtle shell fragments are the only vertebrate fossil recorded in the study area, but other reptiles including lizards, crocodiles, and dinosaurs are known from the Dakota Formation in other areas. Plant imprints, petrified wood, one possible turtle shell fragments and one possible dinosaur track were recorded in the Dakota Formation during the survey (Ka1250T, Ka1251IPV, Ka1260P, Ka1261IP).

PALEONTOLOGICAL SIGNIFICANCE

The following field classification system was used to define the sensitivity of paleontological localities recorded during the field survey (Raup, 1987, p.174):

Class 1. Critical - reference locality for holotype or critical paleontological material, or any type section of geological strata needed for future study

Class 2. Significant - any locality that produces rare, well-preserved, or critical fossils usable for taxonomic, evolutionary, stratigraphic, paleoenvironmental, or paleoecological studies.

Class 3. Important - any locality that produces common, abundant fossils useful for stratigraphic or population variability studies.

Class 4. Insignificant - any locality with poorly preserved, common, or stratigraphically unimportant fossil material.

Class 5. Unimportant - any locality intensively surveyed and determined to be of minimal scientific interest.

The paleontology of the Tropic Shale and Dakota Formation have been extensively studied over the years and now quite well-known. These fossils have been important to understanding this part of the earth's geologic history. Most of the material recorded during the survey falls in or between the categories of insignificant to important. This is because the fossils found are well known and are very plentiful invertebrates. However, they can be useful for stratigraphic or population studies.

Generally, development in formations with common, abundant invertebrate fossils does not highly impact the paleontological resources, but there is always a potential for discovery of new or rare fossils in these formations. Critical and significant fossils are occasionally discovered as is evident from recent finds of vertebrates in the Tropic Shale (Albright, Gillette, and Titus, 2002; and Gillette, Albright, Titus, and Graffam 2002).

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Permit and License numbers: Utah Paleontological Permit # 04-339, BLM Paleontological Resources Permit # UT-S-05-002, Utah Professional Geologist License- 5223011-2250.

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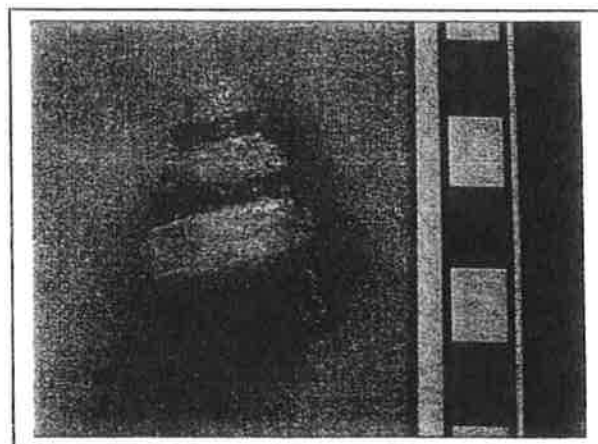
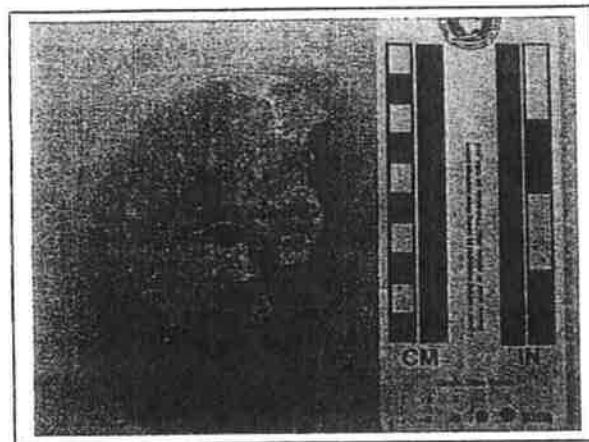
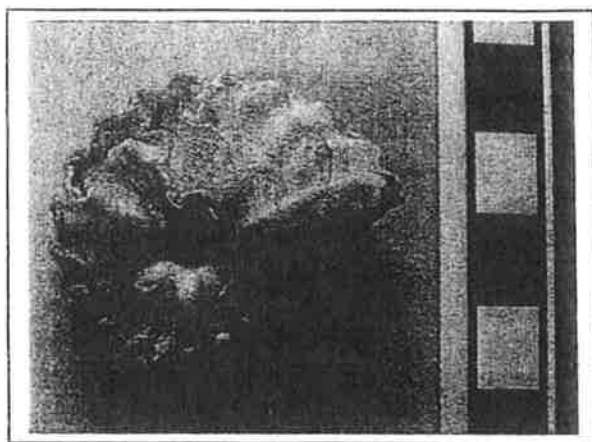
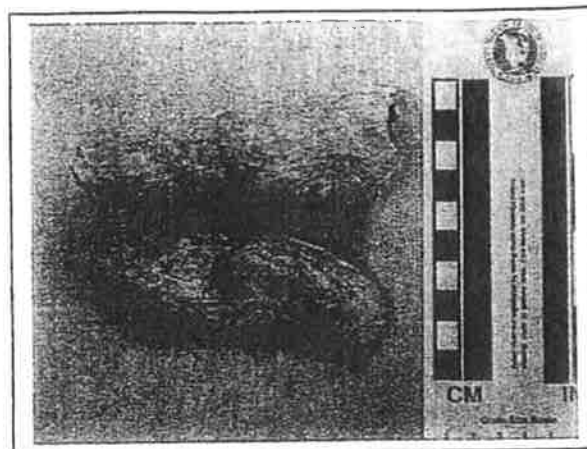
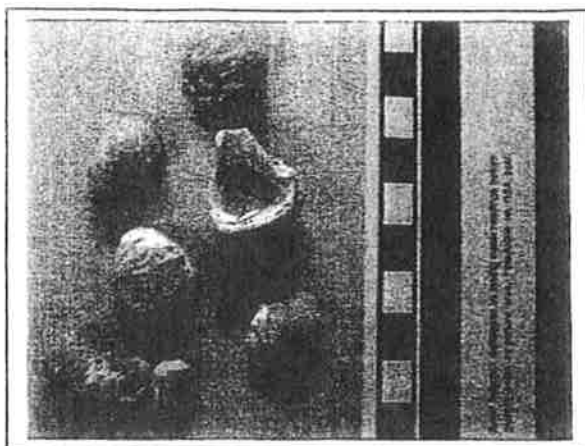


Figure 2. Examples of fossils found (Tropic Shale).

Top row: *Pycnodonte newberryi* and other bivalves.

Middle row: Ammonites.

Bottom row: Gastropod and *Baculites* sp.

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APPENDIX

PALEONTOLOGY LOCALITY DATA SHEETS

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Paleontology Locality
Data Sheet

State Locality No. 42Ka1252I
Agency No. _____
Temporary No. 21, 22, 23, 24, 25, 26.

1. Type of Locality: Invertebrate ☒ Plant ☐ Vertebrate ☐ Trace ☐ Other ☐
2. Formation/Horizon/Geologic Age: Tropic Shale, Cretaceous
3. Description of geology and Topography: In the Alton Amphitheater with low hills and round bottom valleys or draws draining to Kanab Creek. Mountains on east and west sides of the larger valley
4. Location of Outcrop: Three miles south, southeast of the Town of Alton, Utah
5. Map Ref.: U.S.G.S. Quad. Alton, Utah, Scale 7.5 Min., Edition 1966
East 1/2 of NW 1/4 Section 30, T. 39 S, R. 5 W, Meridian : S.L.B. & M.
UTM Grid Zone: 12, (21) 370792 m E 4139064 m N, (22) 370792 m E 4139134 m N,
(23) 370718 m E 4139249 m N, (24) 370580 m E 4139211 m N,
(25) 370574 m E 4139362 m N, (26) 370574 m E 4139585 m N.
6. County: Kane, BLM/USFS District: Cedar City/Kanab BLM
7. Specimens Observed/Collected: Bivalves, gastropods, cephalopods (Baculites and fragments of partially coiled one (22) - Allocrioceras sp.?).
8. Collector: _____ Date: _____
9. Repository/Accession No.s: NA
10. Ownership: PRIV ☒ STATE ☐ BLM ☒ USFS ☐ NPS ☐ IND ☐ MIL ☐ OTHER ☐
11. Recommendations for Further Work or Mitigation: _____
12. Type of Map made by Recorder: Attached
13. Disposition of Photos/Negatives: _____
14. Published References: _____
15. Remarks: _____
16. Sensitivity: Critical ☐ Significant ☐ Important ☒ Insignificant ☐ Unimportant ☐
(Class 1) (Class 2) (Class 3) (Class 4) (Class 5)
17. Recorded by: Alden H. Hamblin Date: September 30, 2005

18. Permit and License numbers: Utah Paleontological Permit # 04-339, BLM Paleontological Resources Permit # UT-S-05-002, Utah Professional Geologist License- 5223011-2250.

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APPENDIX C

GEOLOGIC REPORT OF THE IMPACTS OF BEDROCK
AND SURFICIAL UNITS ON THE DISTRIBUTION OF CULTURAL
RESOURCES AT THE ALTON COAL FIELD,
KANE COUNTY UTAH

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Geologic Report of the Impacts of Bedrock and Surficial Units
on the Distribution of Cultural Resources at the Alton Coal Field,
Kane County Utah

Prepared for:

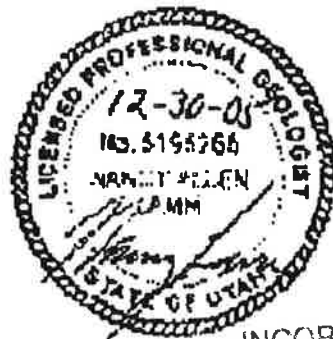
Montgomery Archaeological Consultants
Moab, Utah

Prepared by:

Nancy B. Lamm

Licensed Professional Geologist #5195265
State of Utah

December 30, 2005



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Introduction

At the request of Montgomery Archaeological Consultants a geologic investigation was made of the Alton Coal Field, south of the Town of Alton in Kane County, Utah, for the purpose of determining how the regional geology impacts the distribution of cultural resources present in the project area. The site investigation was conducted on July 14 and 15, 2005. Concurrent with the field investigation, Montgomery Archaeological Consultants personnel were present, completing the survey phase of the cultural resource inventory of the area.

The project area is approximately five square miles in area and consists largely of open, cultivated fields surrounded by low hills. Kanab Creek runs through the project area, flowing from north to south and forms an incised canyon to the west of the southern end of the project area. Lower Robinson Creek extends across a small portion of the southern end of the project area and flows into Kanab Creek west of the project area. An improved gravel road extends south from the Town of Alton through the center of the project area and a number of unimproved roads extend out to the east and west from this central road. Current land use consists of ranching and farming. Historically coal has been mined in several locations on the west side of the project area and several active gravel quarry operations are present in the south portion of the project area.

Procedure

Prior to the field investigation phase, published geologic information of the project area was obtained and plotted onto the U. S. G. S. Alton 7 1/2' quadrangle map for verification in the field. In addition, stereo air photos of the project area were obtained and reviewed prior to the field investigation. Landforms noted on the stereo air photographs were plotted on the topographic map. This preliminary information was verified in the field by walking a series of sweeps in areas accessed by unimproved roads. Project constraints precluded a detailed site investigation but a set of descriptive criteria to assist in cultural resource management decisions was constructed for both bedrock and unconsolidated units. This report provides an overview of the project area geology and outlines the criteria determined in the field.

Project Area Geology

The Alton Coal Field is comprised of relatively horizontal bedrock units of Mesozoic age. To the immediate west of the project area between the Town of Alton and Highway 89, these bedrock units are broken and displaced by the Sevier Fault Zone, extending in a northeast-southwest direction just east of Highway 89 and the Virgin River. Displacement of bedrock units is apparent in the low mountains extending along the trace of this fault zone just west of the project area. Within the project area, bedrock units are exposed as low hills and along the incised drainage of Kanab Creek. Bedrock units exposed in the project area are, from oldest to youngest: the Winsor member of the Carmel formation (Jurassic), the Dakota formation (Cretaceous), and the Tropic shale (Cretaceous) (Sable and Hereford 1990).

Bedrock is deeply weathered and few unweathered outcrops are present within the project area. Bedrock units form topographic highs and are mantled with weathered sandstone and shale sediments. Alluvial valley fill, derived from weathered bedrock, fills topographically low areas. In the northeast portion of the project area an extensive landslide deposit extends downslope from the east. Primary unconsolidated deposits in the project area are, from oldest to most recent: the mass wasting deposits in the northeast

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portion of the project area, alluvial valley fill, and slope wash deposits mantling topographic highs and feathering out across valley fill from adjacent slopes.

Each geologic unit reflects distinct characteristics and criteria that impact the provenance of cultural resources. Figures 1 and 2 show the location of these units within the project area boundaries. A discussion of the potential impacts to cultural resource distribution follows the geologic description.

Bedrock Units

Winsor member of the Carmel formation: The Winsor member of the Carmel formation has a limited distribution of less than twenty acres within the project area. The geologic base map (Sable and Hereford 1990) indicates that the Carmel formation is exposed along a drainage on the southwest slope of a low mountain in the SE/4 of Section 25, T 39 S, R 6 W in the southwest corner of the project area. The Winsor member of the Carmel formation is a fine to medium grained sandstone of coastal plain origin (Sable and Hereford 1990). Due to project constraints, limited surface exposure, and general accessibility, the presence of this bedrock unit was not verified in the field investigation.

Dakota formation: Exposures of the Dakota formation are limited to the western portion of the project area, outcropping along the lower slopes of low mountains along the Kanab Creek drainage. The Dakota formation is described as interbedded claystone, sandstone, and carbonaceous mudstone with minor beds of coal, conglomerate, and ironstone. Regional thickness of the Dakota formation in the vicinity of the Alton Coal Field ranges from 75 meters (250 feet) to 230 meters (750 feet), increasing in thickness from east to west (Sable and Hereford 1990).

The stratigraphy of the Dakota formation is varied and reflects an environment of deposition that includes fluvial, lagoonal, shoreline, and marine depositional environments. Coal units present are up to 1.5 meters (5 feet) thick. The sandstone is light-gray to yellowish gray, resistant and lenticular. The mudstone is gray to very dark gray and non-resistant. The contact of the Dakota formation with the overlying Tropic shale is set at the upper coal zone in the Dakota formation (Sable and Hereford 1990).

Bedrock exposures of the Dakota formation are limited within the project area since slope wash sediments from the overlying Tropic shale largely mantle hillslopes. Several criteria are present, however, to identify the presence of the Dakota formation in the field:

- The location of coal mining activity. Two abandoned coal mines are present within the project area and are located on Figure 1. Exposures of coal seams are concealed by slope wash deposits but the presence of the mines reflects the approximate contact of the Dakota formation with the overlying Tropic shale.
- The presence of orange to brick red ironstone. The ironstone bed noted by Sable and Hereford (1990) is present in the project area as brick red to orange siltstone to fine grained sandstone. This deposit is quarried in several locations in the vicinity of the project area which are noted on Figures 1 and 2. In addition, a gentle topographic rise in the SW/4 of Section 30, T 39 S, R 5 W is capped with this distinctive deposit weathering out as an angular gravel and indicating the presence of the Dakota formation. Since this unit is locally quarried for gravel, however, the brick red ironstone appears as road base and fill within the project area. Presence of the gravel

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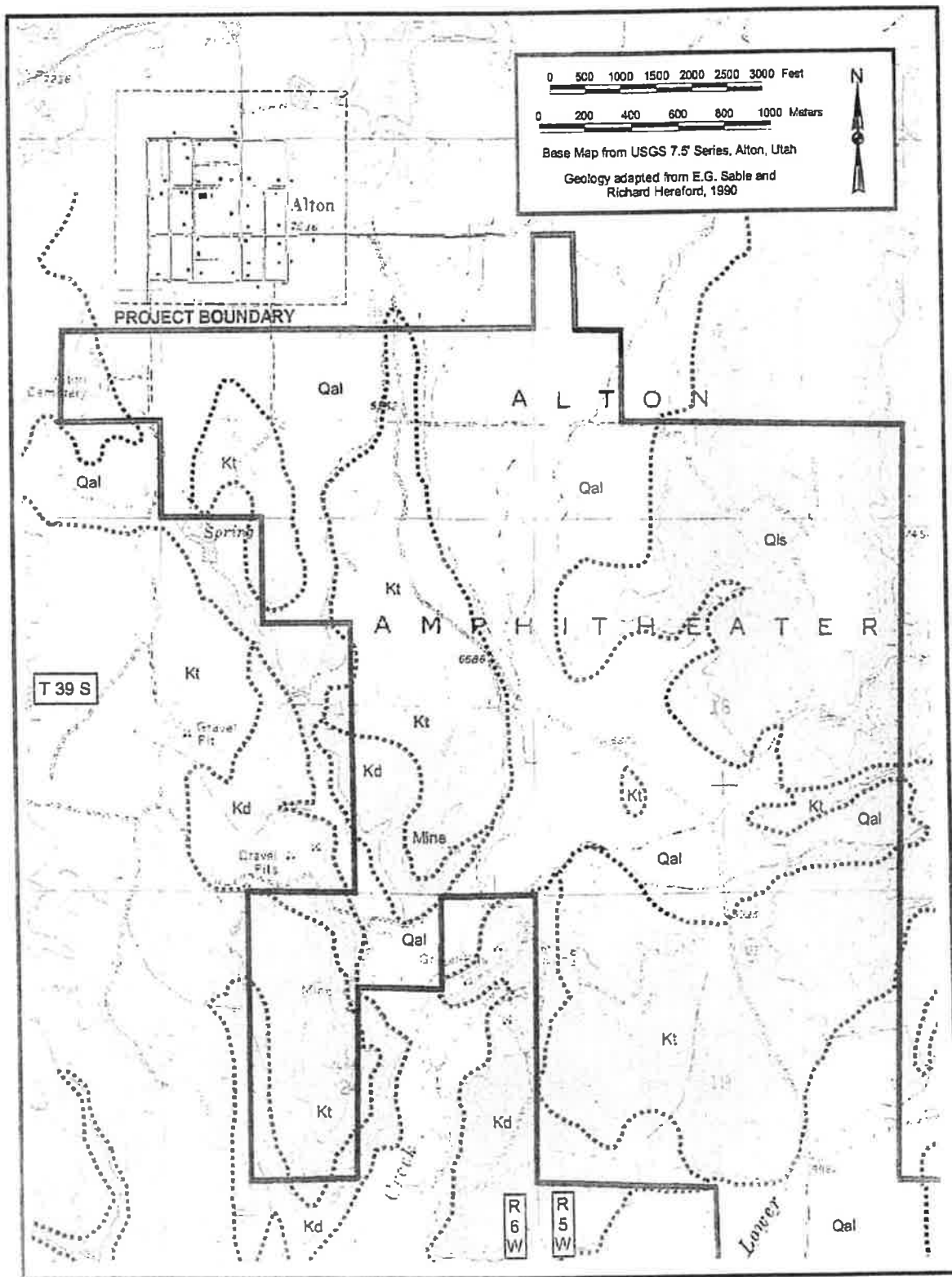


Figure 1. Geologic map of Alton Coal Field, north half, after Sable and Hereford (1990).
Legend appears on Figure 2.

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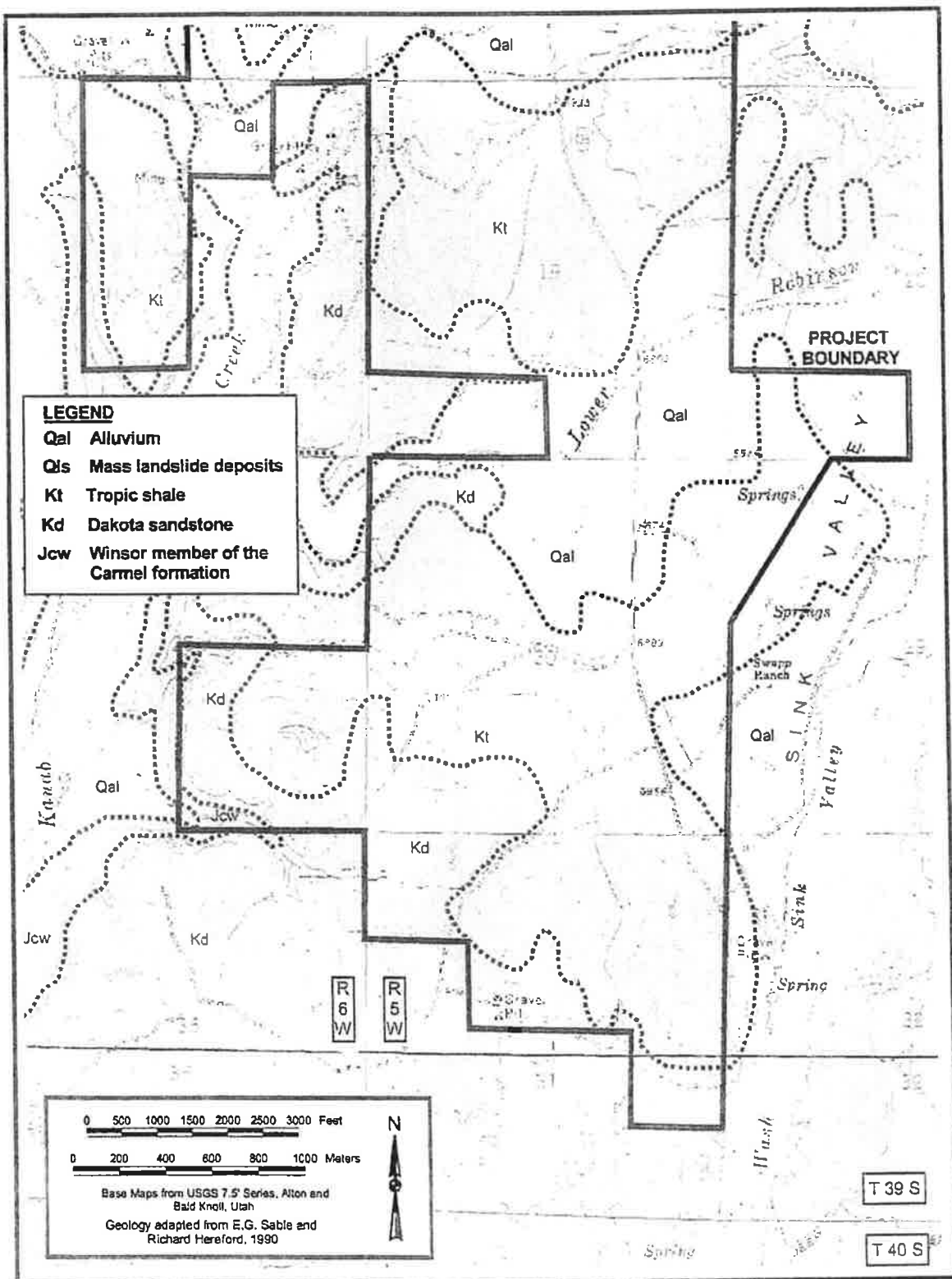


Figure 2. Geologic map of Alton Coal Field, south half, after Sable and Hereford (1990).

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alone should not be used as sole criteria for the presence of the Dakota formation.

Resistant sandstone units of the Dakota formation form benches along hillslopes and along Kanab Creek. Sandstone exposures were also noted along the west side of the low mountain in the SE/4 of section 13, T 39 S, R 6 W. The eroded sandstone units are similar in appearance to sandstone exposed in the overlying Tropic shale. In general, the Dakota sandstone exposures are mantled by slope wash from the overlying Tropic shale, are associated with gravel quarry locations in the vicinity of the project area, and are located along the lower slopes of topographic highs in the southwest portion of the project area.

Cultural resources located on relatively level exposures of the Dakota formation should be stable and limited to the ground surface and soils formed in situ. Slope wash, described in detail later in this report, is a problem on steeper slopes, especially in exposures of the mudstone units.

Tropic shale: The Tropic shale is the most wide spread bedrock unit within the project area. Again, distinct bedrock exposures are limited but the Tropic shale comprises the low hills extending across the southern portion of the project area in Sections 30 and 31, T 39 S, R 5 W, the low divide between Lower Robinson Creek and Kanab Creek in Section 19, T 39 S, R 5 W and the low hills west of the irrigated land in Sections 12 and 13, T 39 S, R 6 W. To the east of the project area in Section 29, T 39 S, R 5 W, the outcrop of the Tropic shale is associated with the occurrence of a number of springs in Sink Valley. It is likely that shallow ground water is seeping down gradient in the alluvial valley fill of Lower Robinson Creek and Sink Valley Wash. Where the alluvial valley fill thins over the outcrop of the less permeable Tropic shale, the ground water daylight as a series of springs.

The Tropic shale is described as slope-forming, drab shale and mudstone with interbedded sandstone and limestone. The shale and mudstone weather to olive gray and yellowish gray. The yellowish-gray sandstone units are cliff forming in places. The mode of deposition of the Tropic shale is largely marine offshore grading to shallow shoreline. Regionally the thickness of the Tropic shale ranges from 90 meters (300 feet) to 305 meters (1000 feet), increasing to the east (Sable and Hereford 1990).

The most widespread exposures of the Tropic shale are along hillslopes mantled with gray sediments. Four low mountains along the western portion of the project area are formed by resistant sandstone horizons in the Tropic shale. Here, hillslopes are steep and mantled with slope wash deposits of eroded gray mudstone along with gravel to cobble size fragments of eroded yellowish sandstone. In the NW/4 of Section 30, T 39 S, R 5 W, angular gray limestone pebbles are eroding out onto the ground surface. Slope wash from the Tropic shale comprises the bulk of alluvial valley sediments making the distinction between eroded shale deposits and alluvial valley fill problematic.

The Tropic shale, with the greatest exposure within the project area, also has the greatest impact to the integrity of cultural resources due to the easily eroded nature of the mudstone and shale that comprise much of the formation. Erosion of sediments is pronounced even in areas with extensive tree growth. In addition, vertical erosion or "piping" of sediments formed in situ on exposures of the Tropic shale may also distort the integrity of buried cultural resources.

Unconsolidated Surficial Units

Landslide deposits: Sable and Hereford (1990) map extensive landslide deposits in the northeast portion of the project area. Extensive forest and vegetative growth obscure this deposit but examination of the

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area by stereo air photography confirms the presence of hummocky landforms reflecting extensive mass wasting. This slope failure complex formed on slopes of the Tropic shale and consists of sediments derived from gray shale along with sandstone and other bedrock debris (Sable and Hereford 1990). No clearly defined scarps or areas of active slumping were noted in the field. The landslide deposits are likely Pleistocene in age and appear to be metastable under the current land use of limited ranching.

Alluvial valley fill: Alluvial valley fill is extensive throughout the project area along the broad, open areas of cultivation and valley floor. Sediments are primarily a drab gray silt derived from the surrounding bedrock shale and mudstone units outcropping within the drainage basin. Occasional lens of coarser grained material are present in cutbank exposures. Drainage incision in the alluvial valley fill is pronounced. A drainage scarp in the vicinity of the mass wasting deposits in the NW/4 of Section 18, T 39 S, R 5 W reaches a depth of approximately 9 meters (30 feet) and is nearly vertical. Incision in other areas of alluvial valley fill is also pronounced with scarps ranging from near vertical to sloping. Vertical piping of fine grain sediments is also present in the relatively flat lying alluvial sediments, especially in irrigated areas.

The alluvial valley fill is primarily a fine grained unconsolidated gray silt to silty sand throughout the project area. Characteristics of the alluvial valley fill include the location in low, relatively level areas of the project area including cultivated fields and the presence of sharply incised arroyos and drainages. Total depth of the alluvial valley fill is not known and likely varies across the project area.

Slope wash deposits: Slope wash deposits are located on hillslopes and as a low wedge along the interface of topographic highs and the alluvial valley fill. Slope wash deposits reflect localized transport of eroded bedrock sediments downslope. Contact of slope wash deposits with alluvial valley fill is gradational as the deposits interfinger with and feather out across the surface of the alluvial deposits.

The stratigraphy of slope wash deposits reflects the bedrock unit eroded and can range from fine grained sediments to small boulders. On hillsides, slope wash deposits are located as mounds on the upslope side of trees and vegetation. In shallow drainages, slope wash may be present as low lobes where eroded sediments were washed downslope during episodes of precipitation. Along the contact with the alluvial valley floor, finer grained sediments are washed out across the valley floor while coarser grained material is deposited along the break in slope. Thickness of slope wash deposits varies across the project area but are most likely relatively shallow. Slope wash deposits were not shown on Figures 1 and 2 due to the limited and intermittent distribution of these deposits.

Geologic Processes Affecting Distribution of Cultural Resources

The geologic setting of the Alton Coal Field area has the potential to impact the distribution of cultural resources by displacement from gravity and/or runoff. There is also the potential for burial and subsequent erosion of cultural resources in the alluvial valley fill. The potential for impact to site integrity is directly related to the topography of the site combined with the bedrock and surficial units identified on Figures 1 and 2. Following is an outline of geologic processes in the Alton Coal Field that have the potential to impact the distribution of cultural resources and the criteria for identification in the field.

Disturbance by gravity:

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pipes occur in the vicinity of incised arroyos and increase in density and size with proximity to the drainage. Pipes and fissures are created as fine grained sediments swell upon wetting and shrink upon drying, forming cracks in the ground surface. During subsequent precipitation events, the fine grained sediments along the sides of the cracks are washed deeper into the fissure. During subsequent drying episodes, the fine grain sediments dry and shrink with the effect of enlarging the fissure. Repeated cycles of wetting and drying result in the formation of pronounced vertical fissures adjacent to drainages. Horizontal seepage of water within the sediment creates connected lateral 'pipes', which collapse, and form tributary drainages. Over time the network of pipes and vertical fissures can extend laterally from the primary drainage for several meters and continue to erode up gradient. The channels of incised drainages are widened as tributary pipes undercut the arroyo walls and collapse.

Piping or collapsing soils are recognized by the presence of vertical cracks in finer grained sediments. These cracks can form from normal precipitation events but are enhanced by flood irrigation practices. The integrity of sites can be impacted by the vertical displacement of artifacts. The alluvial valley fill (Qal on Figures 1 and 2) is comprised primarily of fine grained sediments derived from the surrounding Tropic shale and are subject to piping and/or vertical collapse of sediments. Relatively level exposures of deeply weathered shales of the Tropic shale are also subject to piping to a lesser degree. When cultural resources are located in an area exhibiting vertical fissures in finer grained sediments, some vertical and lateral displacement of artifacts are possible.

Entrenching of drainages is the extension of vertical erosion described above on the drainage system. Major drainages in the project area are incised from 6 to 15 meters (20 to 50 feet) with steep to vertical walls. As in the erosion of weathered bedrock, the incision pattern begins down gradient and migrates up the drainage channel. Piping and collapse of arroyo walls continuously extends the pattern up the drainage basin. The interval of entrenching is likely recent and is associated with a pattern of incision occurring across the southwest dating from the 1880's (Sable and Hereford, 1990).

Cultural resource sites located adjacent to modern arroyo channels are likely compromised by the significant erosion resulting from the drainage entrenchment.

Burial of cultural resources:

Prior to the episode of incision beginning in the 1880's, the channels of Kanab Creek, Lower Robinson Creek, and their tributaries were likely aggrading their channels based on regional depositional patterns. Sable and Hereford (1990) cite regional depositional intervals beginning at 6,320, 5650 to 5,390, 4,330, 2,145, and 340 years before present for drainages located to the south and east of the Alton Coal Field (Sable and Hereford 1990). A similar pattern of Holocene age stream aggradation is likely. The age of the alluvial valley fill in the project area is not specifically known but is likely at least Holocene in part. The possibility for buried cultural resources exists within the distribution of the alluvial valley fill.

Burial of cultural resources is also possible, albeit, to a lesser degree, in the mass landslide deposits in the northeast portion of the project area. Slope failure may result in the displacement or burial of cultural resources.

Summary

The impact of the geology on the distribution of cultural resources present in the project area is summarized in Table 1. The primary surficial and bedrock units shown on Figures 1 and 2 are listed along

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with primary characteristics that may impact the distribution of cultural resources. Impacts are, however, dependent on a number of criteria including degree of slope, vegetation cover, thickness of sediment, current and previous land use, and type of sediment present. Conditions and resultant impacts can and will vary from place to place.

Table 1. Summary of Impacts of Surficial and Bedrock Units on the Distribution of Cultural Resources in the Alton Coal Field Project Area.

<u>Geologic Unit</u>	<u>Map Symbol</u>	<u>Possible Impact to Distribution of Cultural Resources</u>
Alluvial valley fill	Qal	Localized slope failure/collapse of arroyo walls Piping of finer grained sediments Entrenching of drainages Potential for buried cultural resources
Landslide deposits	Qls	Mass and localized slope failure, disturbance to sites Potential for buried cultural resources
Tropic shale	Kt	Localized slope failure Surficial creep on steeper slopes Slope wash on steeper slopes Erosion of weathered bedrock slopes on steep to gentle slopes Piping of finer grained sediments weathered in situ
Dakota formation	Kd	Localized slope failure; one occurrence at abandoned coal mine Surficial creep on steeper slopes Slope wash on steeper slopes Erosion of weathered bedrock slopes on steep to gentle slopes
Winsor member of the Cutler formation	Jcw	Not addressed due to limited distribution in the project area

References

- 1990 Sable, E. G. and Richard Hereford
Preliminary Geologic Map of the Kanab 30' By 60' Quadrangle, Utah and Arizona, **INCORPORATED**
USGS Open File Report Number 90-542.

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Disturbance by gravity is defined as the process by which gravity is the primary agent of disturbance with water as a secondary factor. The three major categories of gravity disturbances present in the Alton Coal Field are mass landslide deposits, small localized slope failures, and surficial creep of soils.

Mass landslide deposits in the project area are defined by Sable and Hereford (1990) as:
 "large coherent blocks of rock in a matrix of clay and smaller clasts, locally exhibiting landslide scarps, sag areas, and downslope creep surface textures" (Sable and Hereford, 1990).

Criteria for recognition of active mass landslide deposits include a hummocky topography, poor drainage including areas of small ponds, seeps and springs, exposed scarps, pistol butting of trees (tree growth on a slope in which the base of the tree curves back into the slope), fences out of alignment, and concave slope failure fractures. The occurrence of the mass landslide deposit in the project area is shown on Figure 1.

The specific impact of mass landslide deposits to the distribution of cultural resources is varied and will depend on site specific conditions. In areas of slope failure, the stratigraphy of cultural resource sites would be compromised and artifacts may be displaced. Sites located on relatively stable portions of the mass landslide deposit will likely be unaffected. The age of the mass landslide deposits is believed to be Pleistocene and Holocene. While older areas of slope failure likely predate occupation and appear to be largely stabilized under current land use, the potential exists for buried and/or disturbed cultural resources in the mass landslide deposits.

Localized slope failure is defined as slope failure on a smaller scale. In the project area slope failure can occur in bedrock units or along the arroyo walls of unconsolidated alluvial deposits. Slope failure along arroyo walls in the alluvial valley fill is largely a result of undercutting of the arroyo walls and will be discussed later in the report.

In bedrock units slope failure results from steep slopes combined with interbedded sandstone and easily eroded mudstone and shale. This potential for slope failure in bedrock increases with changes in land use such as cut and fill excavation, loading at the head of slopes, undercutting at the toe of slopes, and increase in water application. One area of localized slope failure in bedrock in the project area is at the cut face of the coal mine at the NE/4 NW/4 section 24, T 39 S, R 6 W. Here a large scarp, excavated at the contact of the Dakota sandstone with the overlying Tropic shale to provide mine access, has failed. Although the potential for slope failure in the Tropic shale and Dakota sandstone exists in the project area, the minimal impact of current land use has not significantly compromised the distribution of cultural resources.

Surficial creep is the gradual downslope migration of sediments as a response to gravity. Surficial creep occurs in weathered sediments mantling bedrock deposits on steeper slopes. Creep can be recognized by low lateral ridges along exposed hillslopes, accumulation of sediments on the uphill side of trees, and "pistol-butting" of trees, where the base of the tree is curved back laterally toward the hillslope.

Surficial creep occurs predominantly along exposures of the Tropic shale but can occur in the mudstone exposures of the Dakota sandstone as well. Surficial creep was noted on the steeper slopes of the topographic highs on the western side of the project area. The impact to cultural resources is limited to sites located on steeper slopes and would include displacement of artifacts downslope.

Disturbance by running water:

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Disturbance by running water encompasses a range of processes that shift as the degree of slope decreases. Four categories of disturbance by running water have been defined in the project area: slope wash, erosion of weathered bedrock, piping, and entrenchment.

Slope wash is a gradational process that spans surficial creep, described above, where sediments are transported by gravity to water borne erosion of sediments, described below, where sediments are transported by running water. Slope wash occurs where unconsolidated surficial sediments and rock derived from weathered bedrock units are transported downslope by a combination of gravity, runoff from snow melt and precipitation events, and by freeze-thaw cycles in the sediments. This movement is slight and sporadic but over time results in the distribution of sediments and rock debris down the face of steeper slopes and out in a low wedge at the base of slopes.

On steeper slopes, slope wash can be recognized by dispersion of rock fragments below eroding bedrock ledges, by the accumulation of sediments on the upslope side of trees, and by channelizing of rock debris. At the break in slope at the base of the hill, finer grained sediments are washed out in a low wedge. This wedge can be as pronounced as a series of coalescing fans of sediments transported down steep drainages or can be a subtle change in slope gradient from the relatively level valley floor to the base of hillslopes. Where slope wash occurs along the edge of aggrading alluvial sediments, the slope wash deposits interfinger with alluvial sediments. Where recent slope wash occurs along the edge of a stable stream terrace, the margin of the slope wash deposits feathers out across the surface of the terrace. Within the project area, slope wash is occurring along the steeper hillslopes and is more pronounced in areas underlain by the Tropic shale.

The primary impact of slope wash to cultural resources in the project area is downslope displacement of artifacts located on steeper slopes.

Erosion of weathered bedrock slopes is the incision of drainage channels along the outcrop of bedrock units, primarily the Tropic shale although erosion of the mudstone units of the Dakota sandstone is also occurring. Areas of pronounced erosion are identified by incised drainages associated with pedestaled vegetation and concentrations of rock and vegetative debris along incised channels. In the NW/4 of Section 19, T 39 S, R 5 W, in a gently sloping wooded area underlain by the Tropic shale, drainages were incised approximately 10 meters (30 feet) from the surrounding forest floor with one meter (3 foot) vertical sides at the drainage channel itself.

Erosion of weathered bedrock is pronounced in areas of moderate slopes and occurs in areas of forestation. The presence of vegetation tends to lend a mitigating effect to extensive erosion by securing surficial sediments with a root system resulting in the pedestaled vegetation when the surrounding ground surface is eroded.

The impact of erosion of weathered bedrock to cultural resources will vary depending on the degree of erosion occurring in the vicinity of the site. Incision begins at downslope exposures and migrates upslope with drainages extending out in a dendritic pattern. At the head of the drainage pattern, the impact will be slight but increases down gradient as the degree of erosion becomes more pronounced. In areas of heavy erosion cultural resources are likely to be displaced downslope and may be concentrated along drainages. Features may be compromised or destroyed altogether. Given the pedestaled nature of the pinyon-juniper trees along with a regional pattern of erosion dating from the 1880's, the age of the erosional cycle is likely recent.

Piping of finer grained sediments is defined as the formation of vertical fissures and cracks in fine grained alluvial sediments as well as sediments formed in situ on weathered shales and mudstones. These

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